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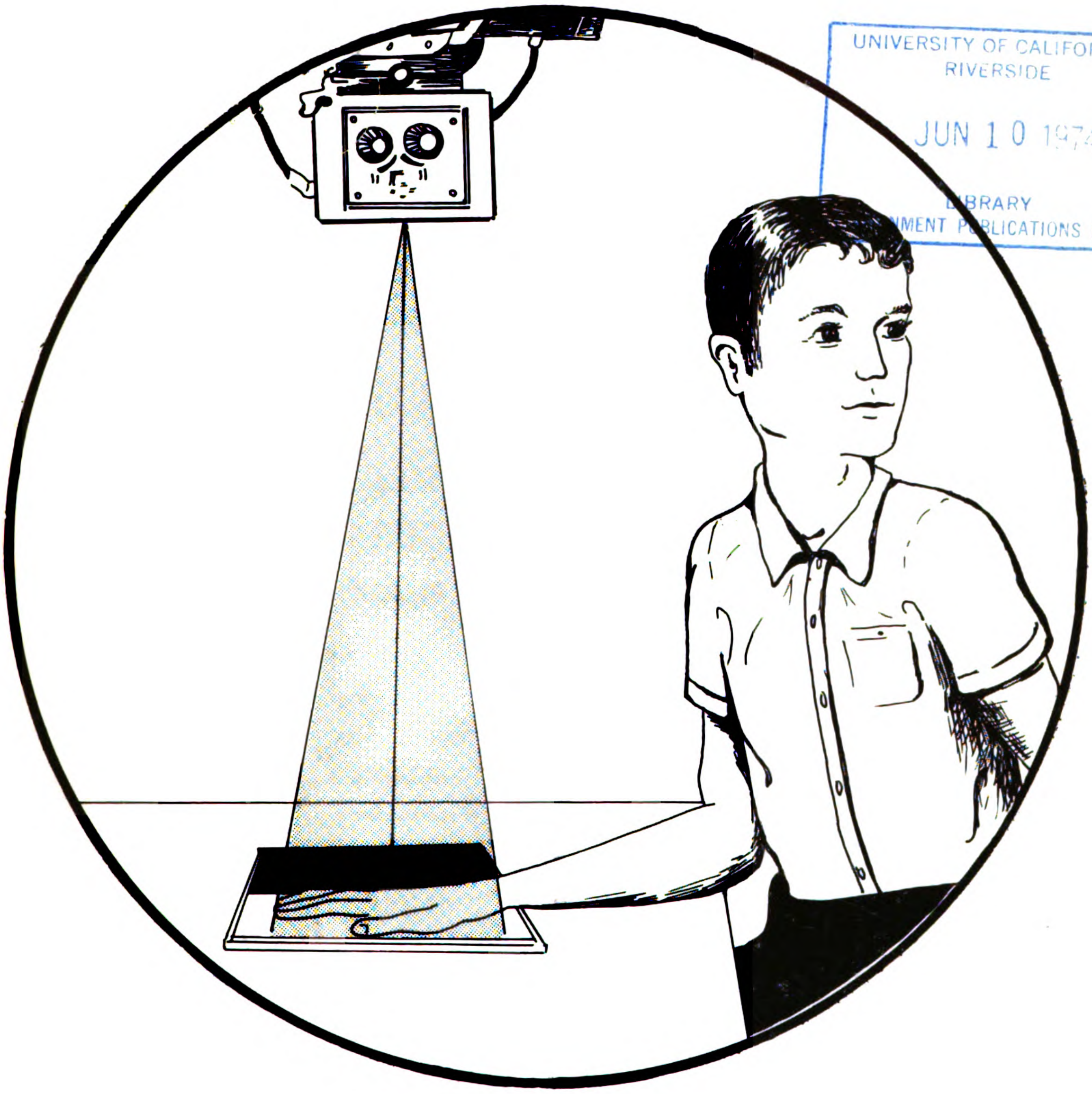

STATE OF CALIFORNIA
DEPARTMENT OF HEALTH
RADIOLOGICAL HEALTH SECTION

EXTREMITIES RADIOGRAPHY

Prepared by

CALIFORNIA STATE DEPARTMENT OF HEALTH

Radiologic Health Section

Simon Kinsman, Ph.D., Chief

Published by

CALIFORNIA STATE DEPARTMENT OF HEALTH

JANUARY, 1974

COPIES OF THIS MANUAL ARE AVAILABLE FROM THE

DEPARTMENT OF GENERAL SERVICES
CALIFORNIA STATE OFFICE OF PROCUREMENT
P. O. BOX 20191
SACRAMENTO, CALIFORNIA 95820

TELEPHONE 916-445-1020

PRICE PER COPY $6.00

FOREWORD

he use of any source of energy since the earliest time of man has always required hat it be done with knowledge and respect for both its potential benefit and harm o man. Such was the case with fire, steam, explosives, electricity, X rays and tomic energy, to mention just a few.

rays were discovered by Wilhelm Konrad Roentgen, a German physicist at the Univrsity of Wurzburg, on November 8, 1895. Even during the first year of its disovery, the deleterious side effects of X rays began to be noticed. Emil H. Grubbe, hat first year, noted an irritation on his hand which resulted from radiation while anufacturing and testing vacuum tubes. Up to the time he died in 1960, he had 83 perations to overcome tissue destruction and degradation resulting from 65 years of xposure.

arly in 1896, M. I. Pupin of Columbia University in New York City made a radiograph, nd C. Edmond Kells, a New Orleans dentist, constructed his own apparatus and prouced the first intraoral radiograph. The subsequent death of Dr. Kells was attriuted to overexposure to X radiation.

ithin the next few months, there were several reports that X rays would produce changes of the skin similar to the effects of sunburn." In his first announcement, oentgen also published information on the hazards of X rays. Within the year, a housand papers and several books had been published on the subject of X rays, their hysiologic effects, proposed uses and shielding.

s early as 1896, Thomas A. Edison made the first fluoroscope using calcium tungtate. However, he discovered that the X rays had an adverse effect on an assistant, aking his hair fall out and ulcerating his flesh. In an article in "Century Magaine" which reported the harmful effect of the X ray, Edison stated, "I then conluded it would not do, and that it would not be a very popular kind of light, so I ropped it."

n 1899, John Dennis, a newspaper reporter, recognized the need for radiation proection and certification. Before the Seventh District Dental Society of New York e declared, "It is my candid judgement that the time has now arrived when the abuse f this God-given energy should be controlled...that no living human being should be ubjected to the Roentgen energy excepting by those who have established their cometence to use it with absolute safety. I am aware that this contention will not ass unchallenged..."

In 1913, the National Bureau of Standards set up a program to standardize radium medical purposes. In the following year, the first death from cancer attributed X rays was recorded. In 1925, Mutscheller presented a concept of dose which may tolerated for a prolonged period of time without causing injury. He expressed it terms of a fraction (0.002 to 0.01) of the erythema dose. The tolerance dose as iated with such a criterion could vary between individuals. It would be in the neighborhood of 100 roentgens per year.

During the late 1920s, American and English radiologists gave consideration to t subject of radiation protective procedures and recommended measures for use in t manipulation of X rays and radium.

In 1925, the International Commission on Radiological Units and Measurements (IC was established under the auspices of the First International Congress on Radiol Three years later, they adopted and defined the roentgen as a unit of X-ray dose. Thus, for the first time, a common unit was used world-wide to measure X radiati During the same year, the International X-ray and Radium Protection Commission w established; subsequently, it became the International Commission on Radiologic Protection (ICRP). Today, the World Health Organization (WHO) utilizes both com tees as technical advisors in the field of radiological units and measurements.

During the 1930s, the incidence of radium poisoning in workers painting luminous dials pointed out the need for internal radiation exposure standards. It also p vided information and procedures for calculating a permissible or acceptable dos for humans.

Over the following decade, radiation protection appeared to be a problem of pure academic interest except to a relatively small number of concerned people who rec nized the real dangers that were almost certain to arise as radiation uses increa These individuals actively sought standards of adequate radiation protection. Th activities undoubtedly prevented massive damage to the entire human race during t early 1940s when the Atomic Era opened with a large-scale demonstration of the f sustained nuclear fission reaction during World War II.

In the early 1950s, the commonly-used, shoe-fitting fluoroscope was outlawed for stores. Section 638 of the California Penal Code states that no X-ray fluoroscop nor other equipment employing roentgen rays, shall be used for fitting footware o in viewing bones of the feet. However, the section exempted any licensed physici surgeon or other person practicing a licensed healing art, or any technician working under the direct and immediate supervision of such a person.

In 1959, a bill was introduced in the California Assembly to require the State to regulate X-ray usage to protect the public from radiation hazards. Although this bill did not pass, it was sent to the Assembly Interim Committee on Governmental Efficiency and Economy for interim study. In September, 1959, this committee conducted hearings in Los Angeles. These produced substantial testimony indicating that inadequately trained and even incompetent personnel were operating X-ray equ ment in medical offices, and one witness described several cases of gross incompetence in this connection.

Consequently, this interim committee recommended that the 1959 legislation be reintroduced in the next general session of the legislature (1961). This bill (AB 1317) was identical to the 1959 one. It was amended twice and died in the Assembly Committee on Governmental Efficiency and Economy. However, in this 1961 session of the California Legislature, a Radiation Control Law was enacted to provide an effective State system of regulations for sources of ionizing radiation. Sections 30305 to 30314 of Title 17 of the California Administrative Code, which refer to such matters as shielding, tube housing, switches, filters and the like, established requirements for safety of X-ray equipment used in the healing arts.

But the law did nothing to upgrade the skill, education or training required for operators of medical X-ray machines. As a practical matter, anyone still could legally use an X-ray machine on humans in California. To be sure, there was a statement that a user of X-ray equipment in the healing arts "shall ensure that all X-ray equipment under his jurisdiction is operated only by persons adequately instructed in safe operating procedures and competent in safe use of the equipment." However, it was evident that this provision had no enforceable standards; likewise, there still was no provision that practitioners of the healing arts had to supervise the operation of medical X-ray equipment.

In 1963, Senate Bill 1480 was introduced to set up standards for operators of X-ray machines (generators), but did not pass. It was sent to the Senate Factfinding Committee on Public Health for interim study and for consideration of whether or not the State should establish educational and training standards for persons using X-ray machines on humans for medical purposes. In 1964, this committee conducted hearings at which it again recorded testimony little different from what was discovered in 1959. Taking X rays was still being entrusted largely to an office nurse, an office receptionist or some other assistant. Often their instruction was limited to following the equipment manufacturer's printed instructions, which covered only the mechanics of operating the equipment.

In February, 1965, the Senate Factfinding Committee on Public Health and Safety published a report which included a section on the subject of Certification of X-ray technicians, and which included arguments for and against the proposal. The argument against the proposal favored a voluntary system of controls, which had previously been attempted from 1964 until 1969, but had proved to be ineffective.

The argument in favor of establishing State requirements included the following points, among others: 1) Voluntary action by the medical profession is an unattainable ideal. Although partly self-disciplining, the medical profession does not have the power to require all medical practitioners to limit their use of X ray to the degree of their competence. 2) The present voluntary system permits an absence at the crucial time and place: when the patient is X-rayed. The evidence was great that many medical practitioners were not qualified to do all kinds of medical X-ray work with maximum safety. Enactment of State requirements for X-ray machine operators would increase, not detract from, the doctor's responsibility.

This Committee came to the following conclusion:

> "Government regulation of radiation sources has been inaugurated in the realization that regulation is necessary to protect the living population

> and future generations from the hazard of unnecessary radiation. Because medical X-ray machines comprise the major source of public exposure, elimination of unnecessary medical radiation will greatly reduce the total amount of radiation and will enhance the public welfare. Regulation of equipment is not by itself sufficient; there is much evidence that improperly trained people can and do operate medical X-ray machines..."

The Committee also recommended that legislation be enacted to require the X-ray technician, the radiologic technologist, and the licentiate of the healing arts demonstrate their competency in roentgenological technique and radiation safety.

In 1968, certification legislation passed the State Legislature, but was vetoed the Governor. At approximately the same time, however, similar legislation was successful in Puerto Rico, New York State and New Jersey.

In 1969, the present legislation, which appears now as Sections 25660-25699.2 of California Health and Safety Code, became law. Section 25660 of Article 1, Decl ation of Policy, of this law states: "The Legislature finds and declares that t public health interest requires that the people of this state be protected from cessive and improper exposure to ionizing radiation. It is the purpose of this chapter to establish standards of education, training and experience for persons use X rays on human beings and to prescribe means for assuring that these standa are met."

Following the signing of the bill, the Department began the organizational work essary to carry out the provisions of the bill. A Radiologic Technology Certifi tion Committee was appointed from names nominated by a variety of organizations. Duties of the certification committee were stated in the law as, "to assist, adv and make recommendations necessary to insure the proper administration and enfor ment of the provisions of this chapter, and for those purposes to serve as consu tants to the Department."

Not long after the committee began to function, they recommended that the Radiol Health Section should undertake the publication of manuals to be used as trainin and procedure guides for the permittees in nine categories which are (1) chest r iography, (2) dental laboratory radiography, (3) gastrointestinal radiography, (genitourinary radiography, (5) leg radiography, (6) musculoskeletal radiography, (7) photofluorographic chest radiography, (8) skull radiography and (9) extremit radiography.

The Extremities Radiography manual is concerned with the basic knowledge necessa to the radiographic examination of the upper and lower extremities which are def as the clavicle and scapula and the heads of the humerus and femur and all anato cal structures distal thereto. Included are discussions of X-ray terms, the radi graphic routine, osteology, surface anatomy and the positioning and techniques re lated to radiography of the extremities. Forty-three different positions and sta ing techniques are described.

Another manual, the Core Manual, should be considered as a supplement to this. I contains the concepts of general health care, basic physics, and radiation protec tion. The Core Manual will be published a few months after this manual.

ACKNOWLEDGMENTS

I hereby express my appreciation to the following for their valued aid in preparing this Extremities Manual. First and foremost, I thank Bernice A. Simon, CRT, who is Chief X-Ray Technologist II, Los Angeles County--University of Southern California Medical Center, for her valued voluntary assistance in reviewing the manual.

Among staff members of the Radiologic Health Section of the California Department of Health, and others, recognition of the following contributions are in order: Val Zemitis and Jerome Caplan, who established the format of presentation and content of this and other radiologic technology manuals; Donna Juds and Charles Carlstein, who were active technical advisors; Mary Ann Strecker, who was the typist and layout coordinator; Amasa Cornish, who was the project coordinator; and Marge Meredith,who was the illustrator.

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CHAPTER I

EXPLANATION OF TERMS

EXPLANATION OF TERMS

Every X-ray technician will acquire a new and specialized vocabulary. Many of the terms in this vocabulary relate, in a general way, to the practice of health care. Many relate, in a specific way, to the use of X rays in the medical profession. X-ray technicians must know the exact meaning of these terms in order to communicate their knowledge.

PLANES OF THE BODY

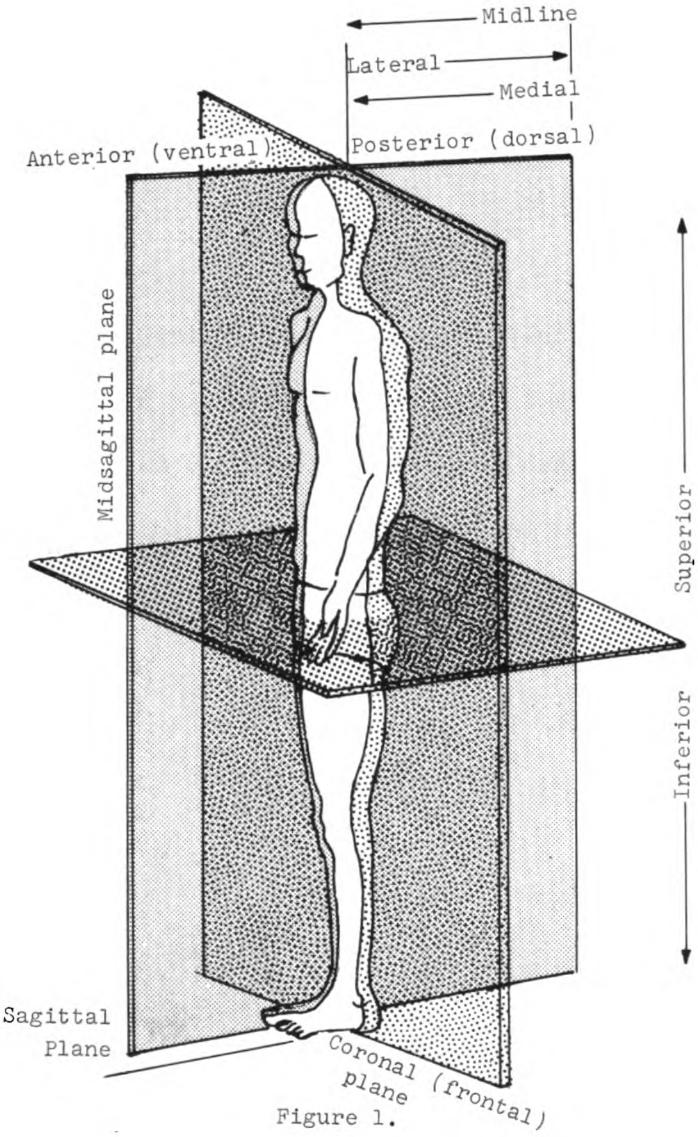


Figure 1.

Planes of the body.

For purposes of reference, it is convenient to imagine the body divided into various parts by a series of planes. The planes are useful as reference points in locating anatomical structures. As shown in Figure 1, the median or midsagittal plane divides the body into rig and left halves on its vertical axis. This plane passes throug the sagittal suture of the cranium, and therefore any plane parallel to it is called a sagittal plane. Frontal planes are draw perpendicular to the sagittal lines and divide the body into anterior and posterior sections. One of these frontal planes divides the body into anterior and posterior halves. Since this line passes through the coronal suture of the cranium, frontal planes are also called coronal planes. The horizontal or transverse plane, which is drawn at right angles to both sagittal a frontal planes, divides the bod into superior and inferior sections.

MEDIAN OR MIDSAGITTAL PLANE

The median or midsaggital plane is the vertical plane that divides the body into right and left halves (equal portions).

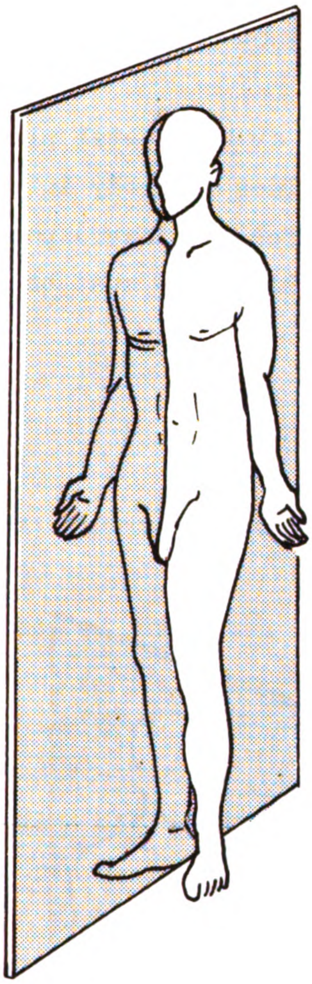


Figure 2A.
Median or midsagittal plane.

FRONTAL OR CORONAL PLANE

The frontal or coronal plane is any vertical plane that divides the body into anterior (front) and posterior (back) portions.

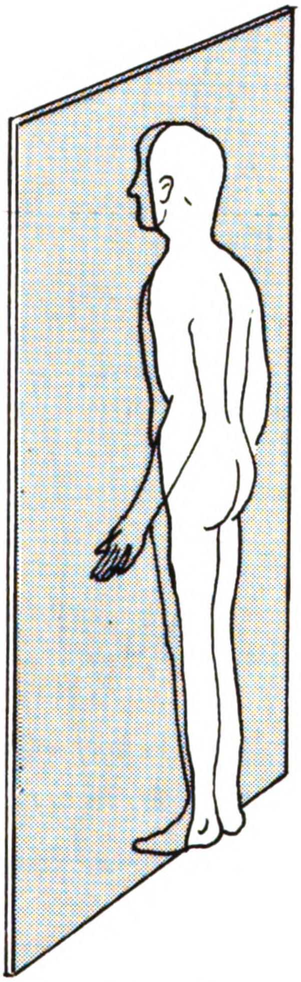


Figure 2B.
Frontal or coronal plane.

TRANSVERSE OR HORIZONTAL PLANE

The transverse or horizontal plane is any plane that divides the body into superior (upper) and inferior (lower) portions. The level of this plane must be given.

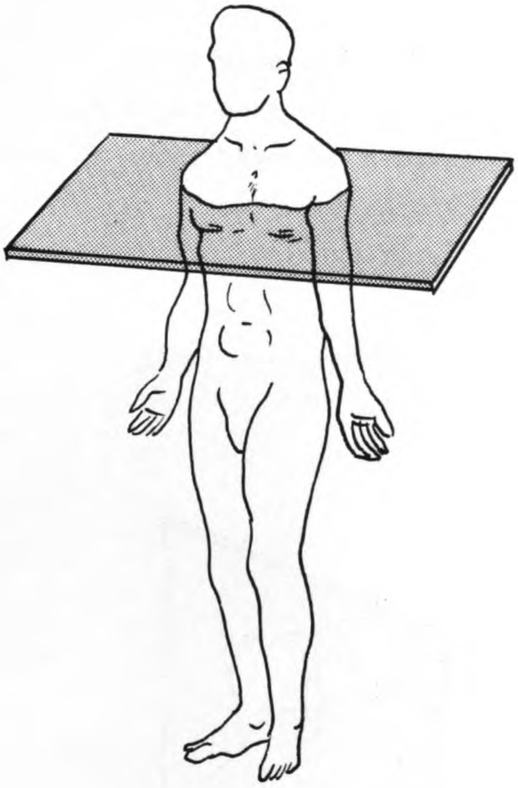


Figure 3A.
Transverse or horizontal plane.

SAGITTAL PLANE

The sagittal plane is any vertical plane that divides the body into right and left unequal portions.

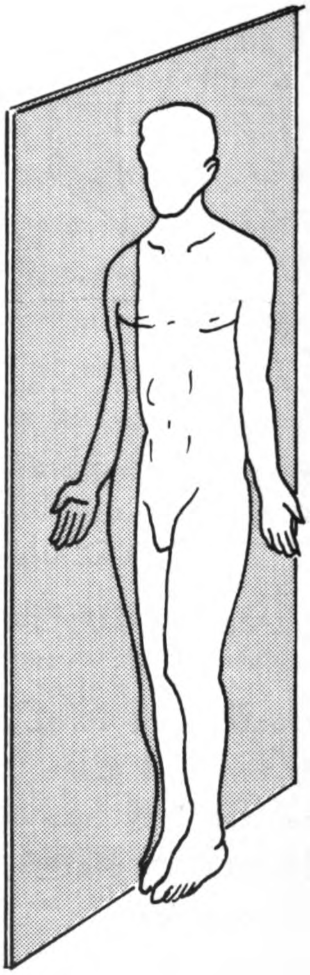


Figure 3B.
Sagittal plane.

NORMAL ANATOMICAL POSITION

This position of the human body is arbitrarily taken to be the erect (standing) position, with feet flat on the floor, upper extremities (arms) at the sides, with the palms of the hands and the eyes directed forward.

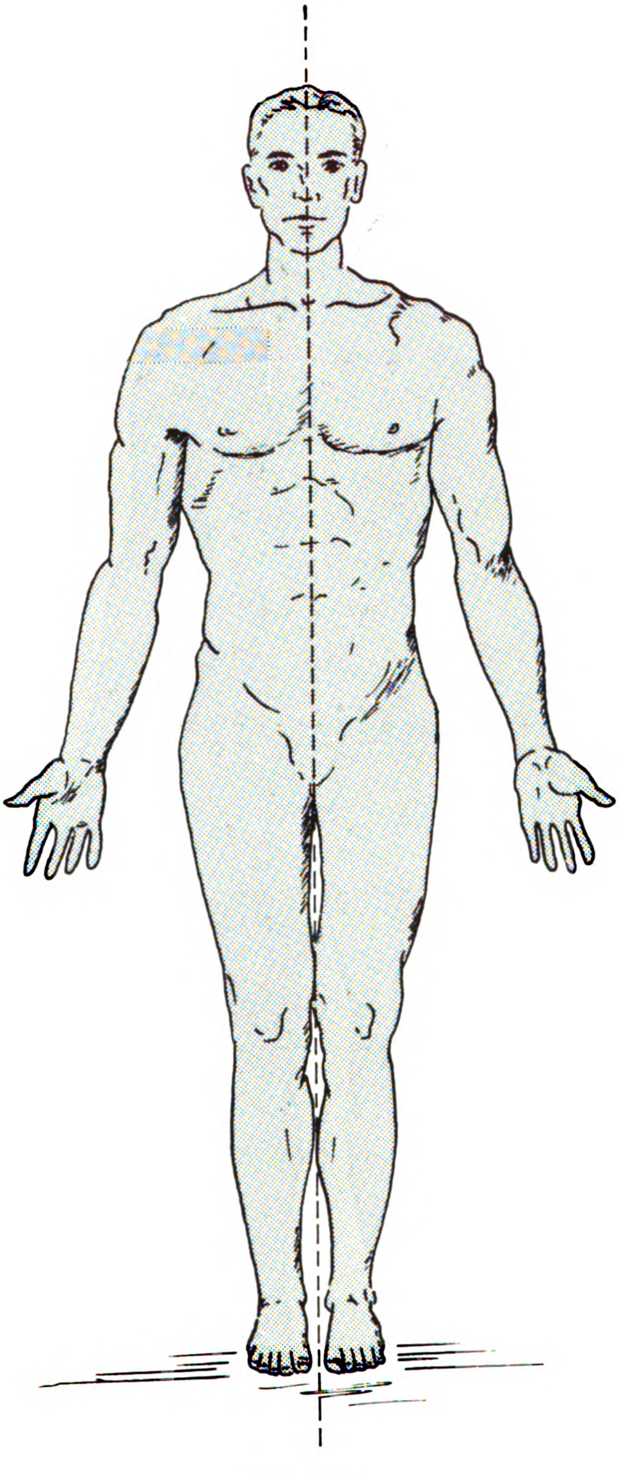


Figure 4.
Normal anatomical position.

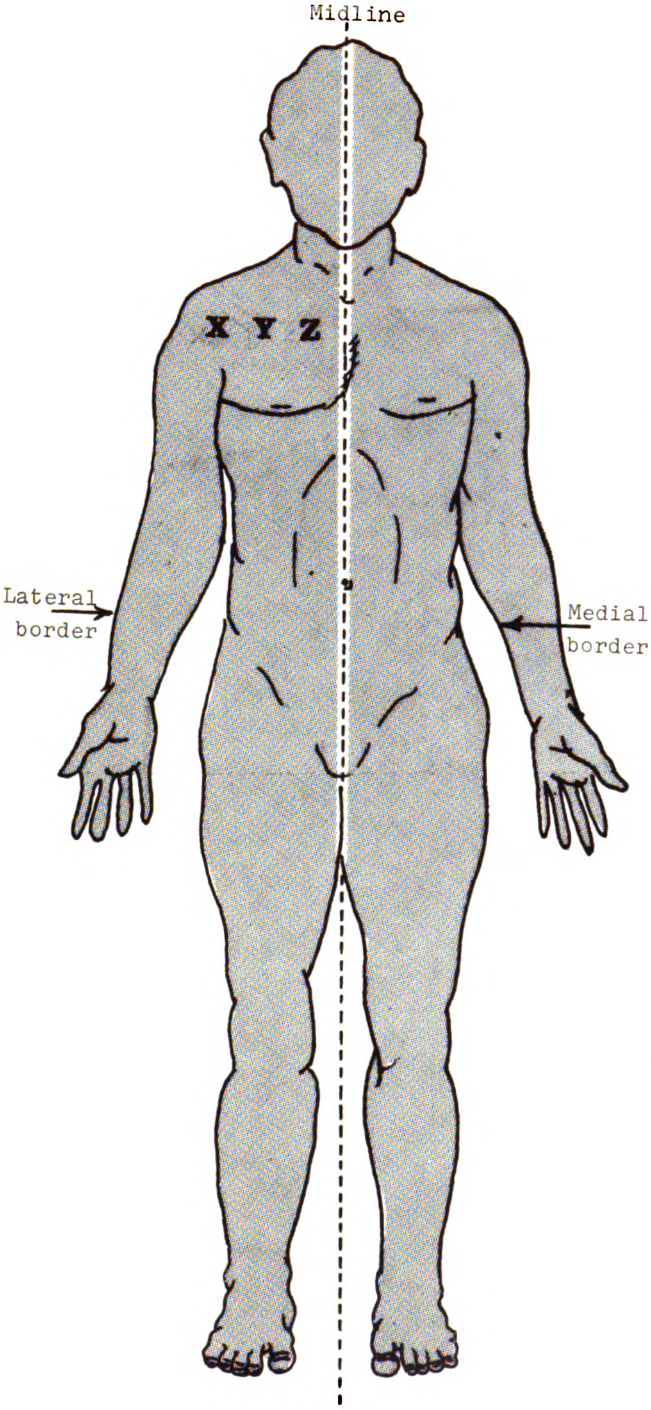


Figure 5.
Body part relationships.

BODY PART RELATIONSHIPS

The words lateral and medial are used to express the relationship of one point of the body surface with respect to another as related to an imaginary line called the midline, down the center of the body. Observe three points, X, Y and Z, as shown on the right breast of the figure with reference to the midline. All three are to the left of the midline; X, however, is farther from the midline than either Y or Z. To describe this relative position, we say that X is lateral to Y and Z; in the same manner, Y is lateral to Z. Because both Y and Z are closer to the midline than is X, we say that Y and Z are medial to X; in the same manner, Z is medial to Y. In general, a point farther from the midline than another point is lateral to the second point; also, a point that is closer to the midline than another point is medial to the second point.

Front, Anterior or Ventral:

Each of these descriptive words refers to the front part of the human body, or toward the front.

Back, Posterior or Dorsal:

Each of these descriptive words refers to the back part of the human body, or towards the back.

Superior Aspect:

The word superior is used in reference to the upper surface of an organ or other structure; also, situated above with reference to another organ or surface.

Inferior Aspect:

The word inferior is used in reference to the lower surface of an organ or surface; also, situated below with reference to another organ or surface.

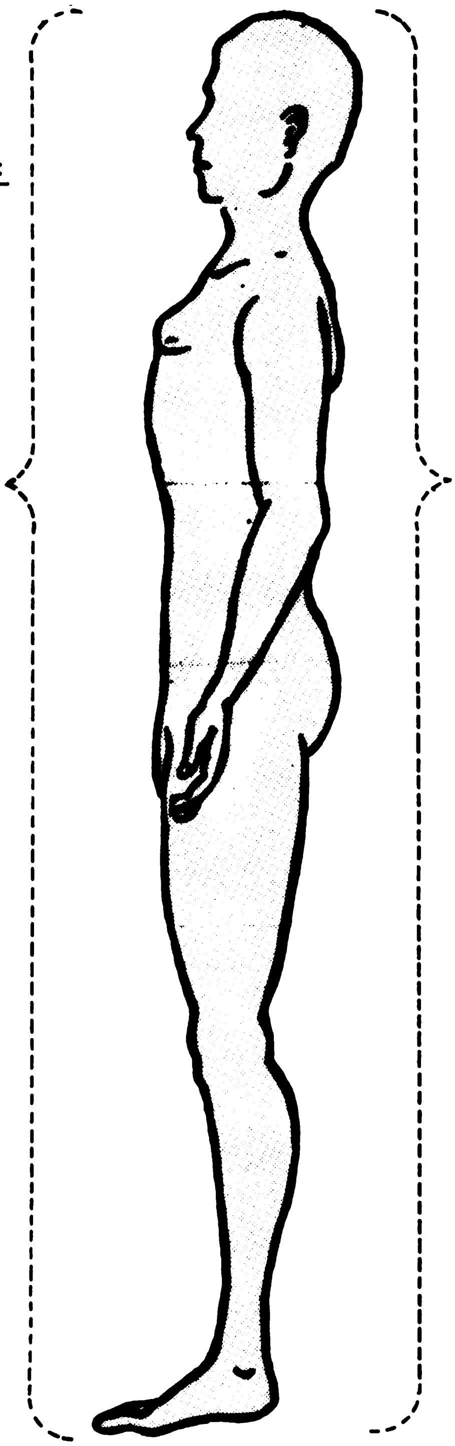


Figure 6A. Side or lateral view of figure

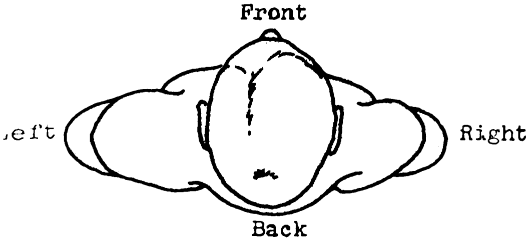


Figure 6B. View from above, or superior

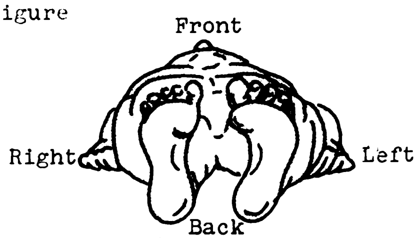


Figure 6C. View from below, or inferior

PROXIMAL-DISTAL RELATIONSHIPS

PROXIMAL

Nearest to a point under consideration or the point of origin. In the case of the extremities, the midline of the body is taken as this point; and the joints are considered points of origin.

DISTAL

Remoteness from a point under consideration or the point of origin; the opposite of proximal. In the case of the extremities, the midline of the body is taken as the point of comparison, and the joints are considered points of origin.

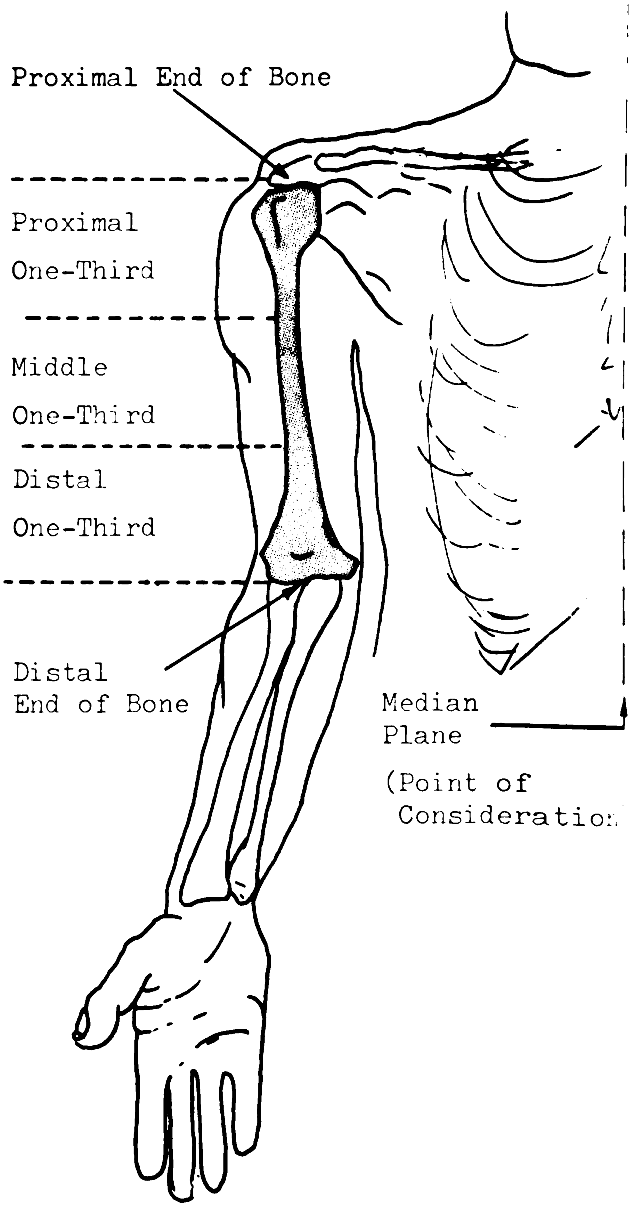


Figure 7.
Proximal-distal relationships.

ERECT OR VERTICAL

pright position, standing or sitting.

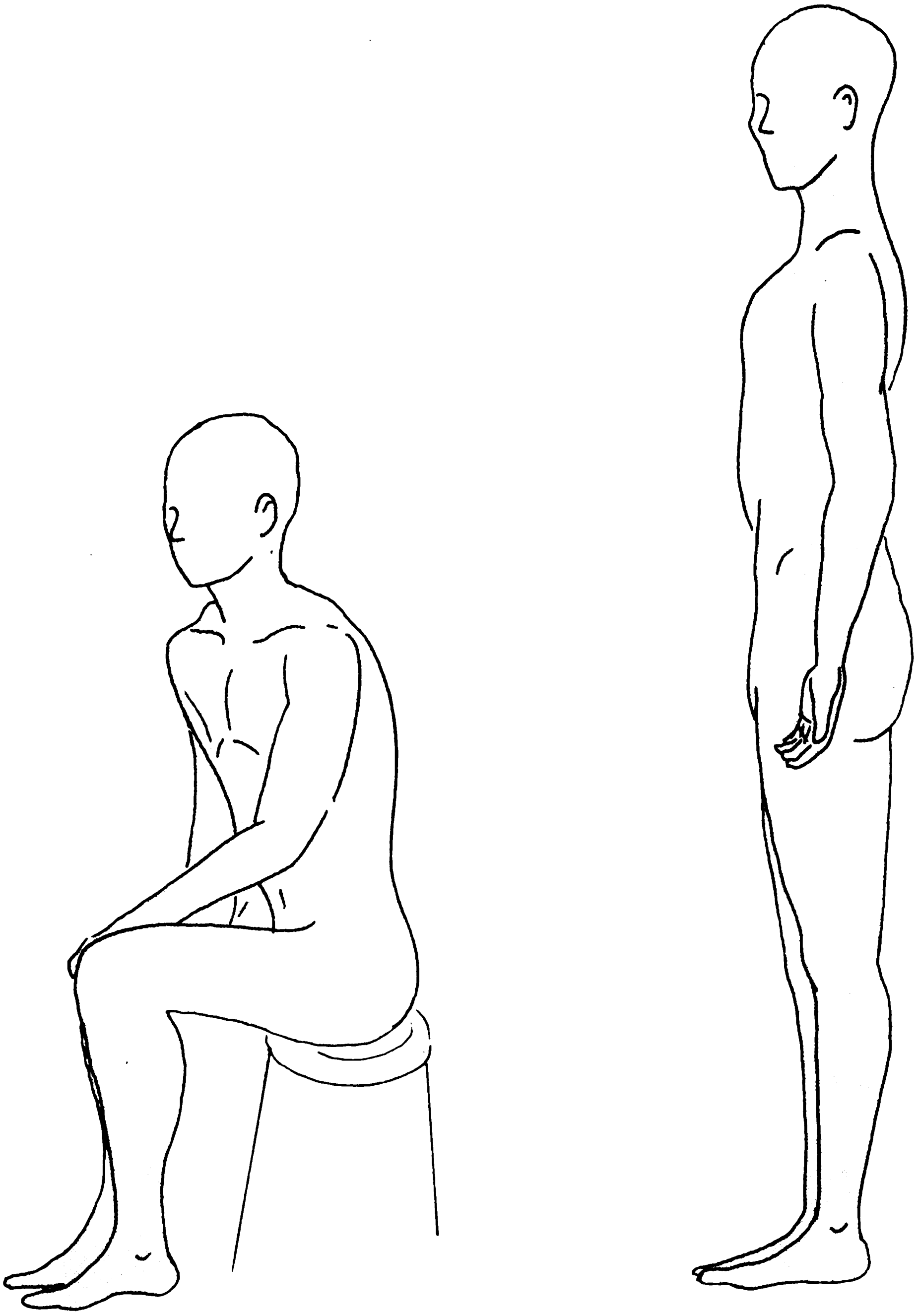


Figure 8.
Erect positions.

SUPINE

Horizontal position,
body flat on the back.

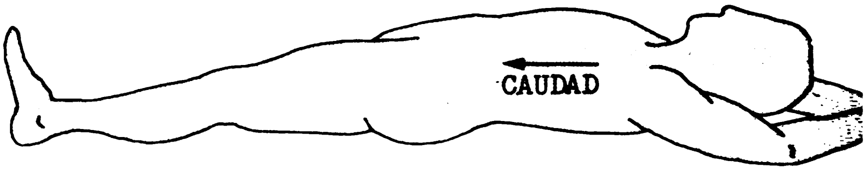


Figure 9A.
Supine position.

PRONE

Horizontal position,
body with face and
stomach down.

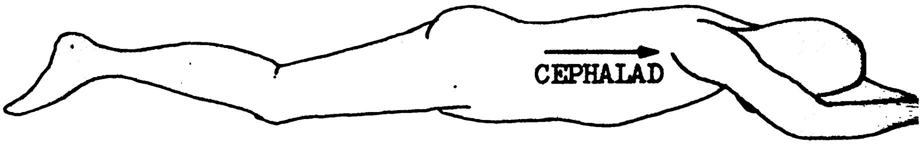


Figure 9B.
Prone position.

LATERAL RECUMBENT

Horizontal position,
body on the side.
Right or left lateral.

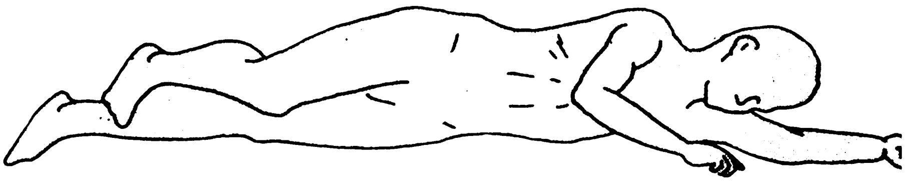


Figure 9C.
Left lateral recumbent position.

DIRECTION OF THE X-RAY BEAM

A roentgenographic position, or rojection, is often referred to by the natomical surfaces where the X-ray eam enters and leaves the body (Figre 10).

The letters PA stand for posteriornterior and tell us that the X rays ntered the body at the posterior, or ack or dorsal surface, proceeded hrough the body and exited the body t the anterior, front or ventral surace.

The letters AP stand for anteror-posterior and tell us that the X ays entered the body at the anterior, ront or ventral surface, proceeded hrough the body and exited at the osterior, back or dorsal surface.

The same comments apply to the eet, where the upper surface is the nterior surface and the bottom surace is the posterior surface.

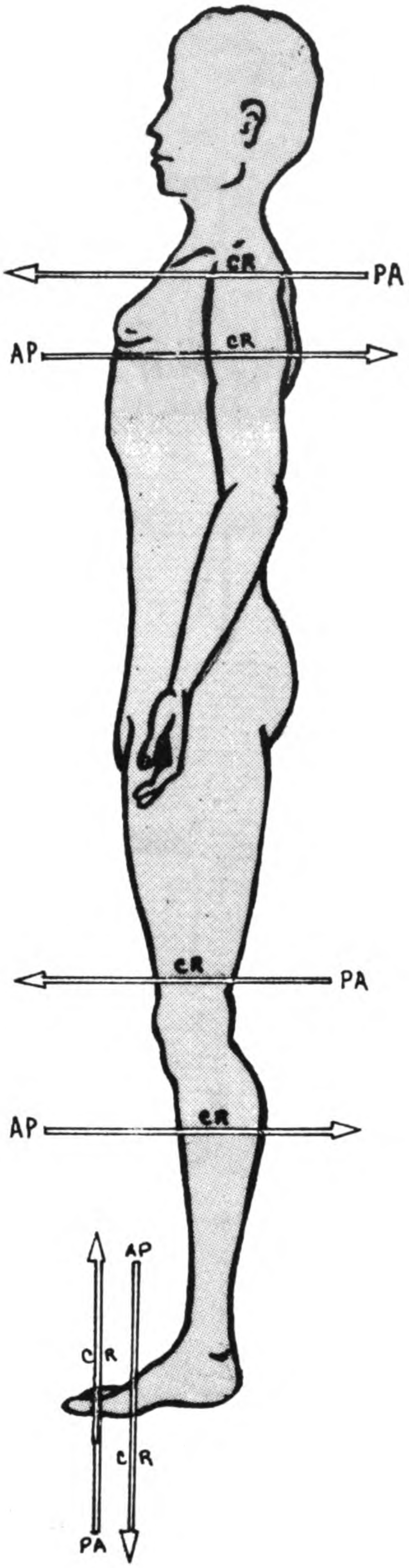


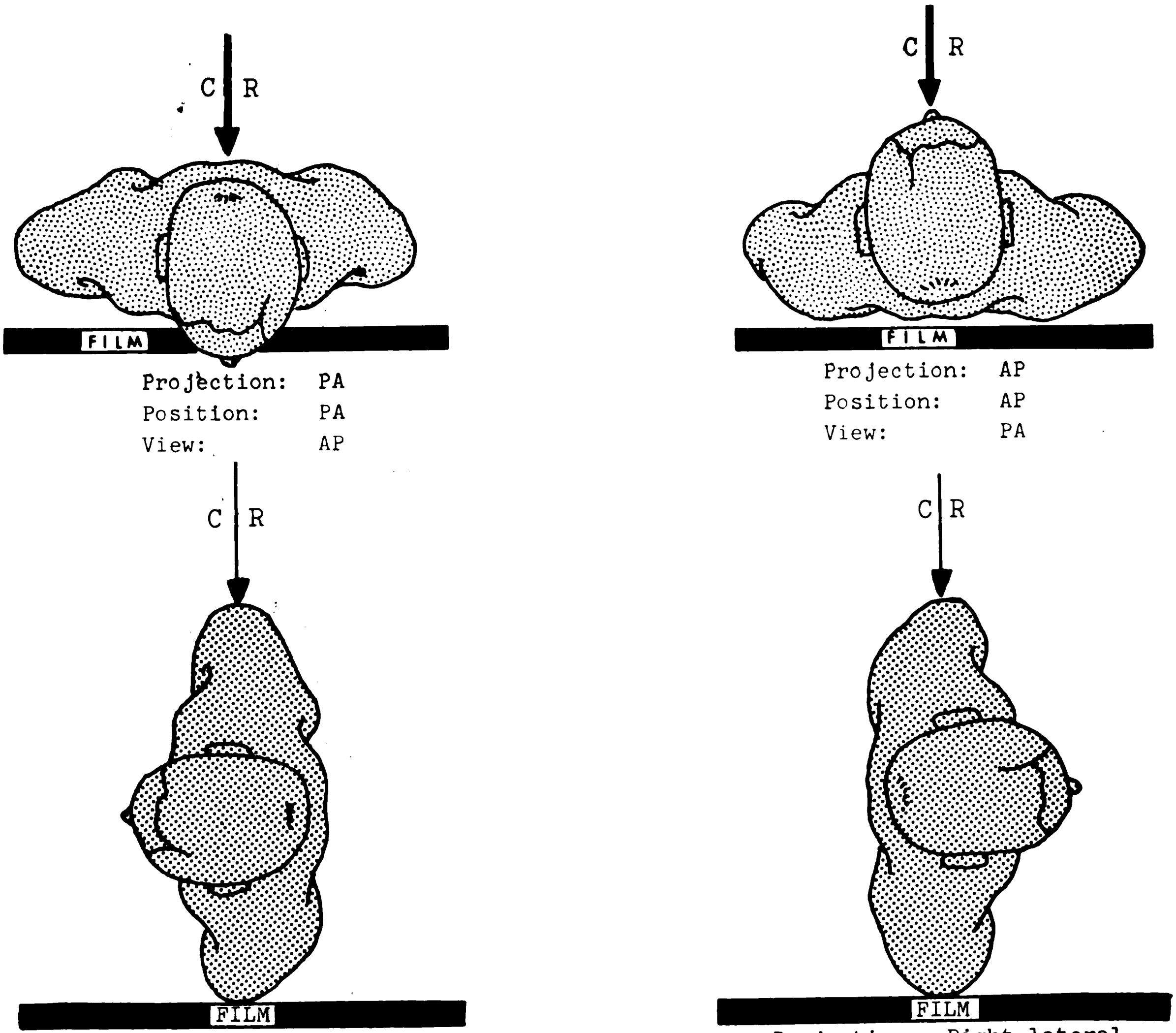
Figure 10.
Direction of the X-ray beam.

POSITION, PROJECTION AND VIEW

In this manual, these terms are defined as follows:

Position and projection:	These terms are synonymous and apply to the tube s of the part as we face the film.
View:	This term has an opposite meaning and applies to t film side of the part as we face the tube.

View is frequently used incorrectly to mean position or projection, therefore it important to understand the correct meanings of these terms.



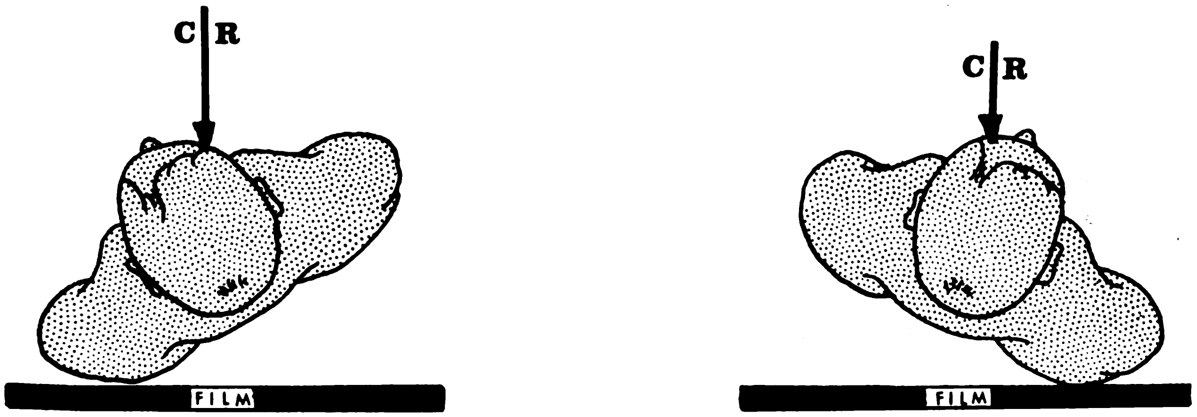
Projection: PA
Position: PA
View: AP

Projection: AP
Position: AP
View: PA

Projection: Left lateral
Position: Left lateral
View: Left lateral

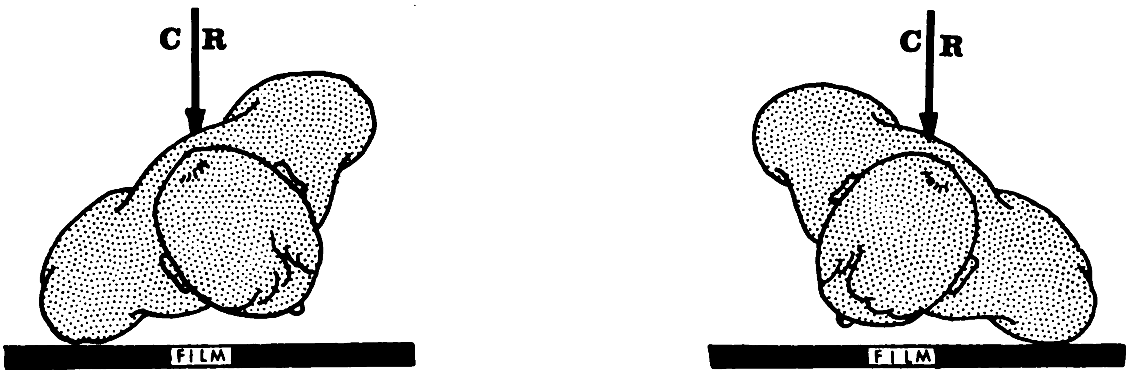
Projection: Right lateral
Position: Right lateral
View: Right lateral

Figure 11.
Positions, projections and views.



Projection: LAO
Position: LPO
View: LPO

Projection: RAO
Position: RPO
View: RPO



Projection: RPO
Position: RAO
View: RAO

Projection: LPO
Position: LAO
View: LAO

Figure 12.
Oblique positions, projections and views.

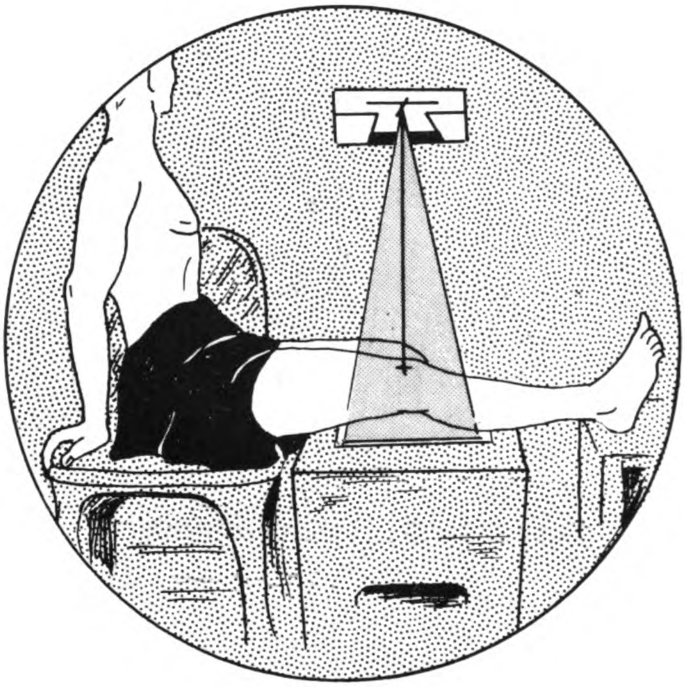


Figure 13A.
Anterior-posterior projection
of the right knee.

ANTERIOR-POSTERIOR

The anterior-posterior (AP) pro jection is made with the part i the supine position. The AP projection is designated by the posterior surface nearest the film.

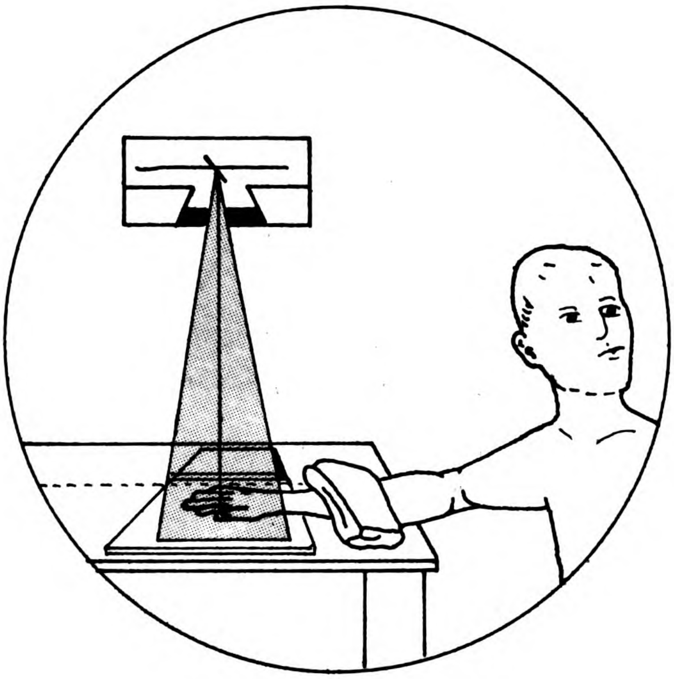


Figure 13B.
Posterior-anterior projection
of the right hand.

POSTERIOR-ANTERIOR

The posterior-anterior (PA) pro jection is made with the part i the prone position. The PA pro jection is designated by the anterior surface nearest the film.

OBLIQUE PROJECTIONS

An oblique projection is made with the part at an angle to the film. The oblique projection is designated by the side nearest the film and the surface facing the tube.

For the extremities, there are two oblique projections: medial oblique (internal rotation) and lateral oblique (external rotation).

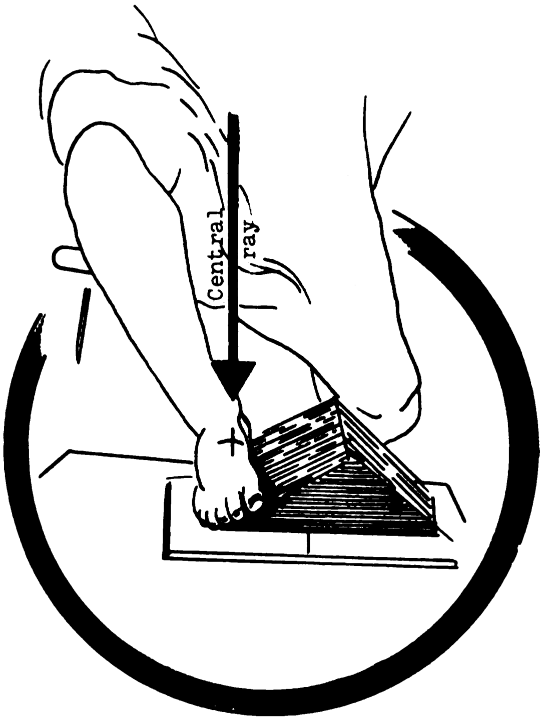


Figure 14A.
Lateral oblique projection
(external rotation).

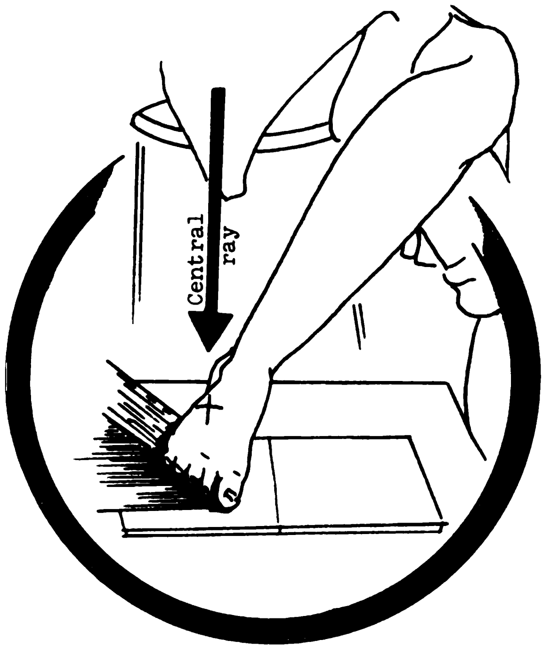


Figure 14B.
Medial oblique projection
(internal rotation).

OBLIQUE PROJECTIONS

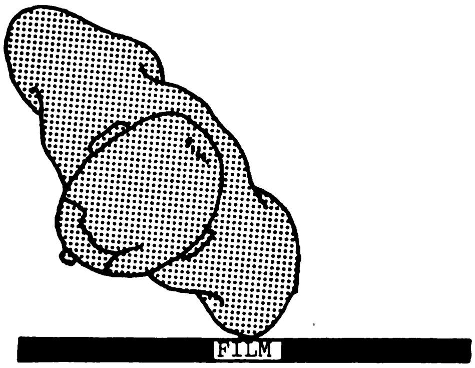


Figure 15A.
Right posterior oblique projection.

If the patient faces the film, with th right shoulder and hip close to the fi and the left shoulder and hip away fr the film, the position, projection is described as right posterior oblique (RPO), since the right side is nearest the film and the posterior surface is facing the tube.

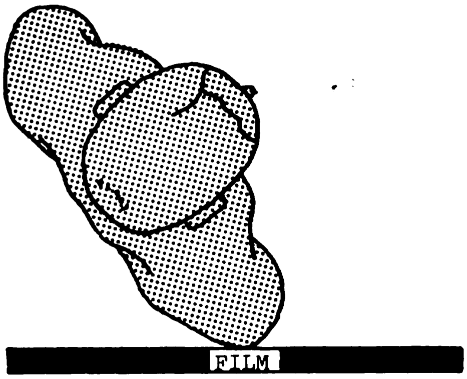


Figure 15B.
Left anterior oblique projection.

If the patient faces away from the fil with the left shoulder and hip close t the film and the right shoulder and hi away from the film, the position, projection is described as left anterior oblique (LAO), since the left side is nearest the film and the anterior surface is facing the tube.

LATERAL

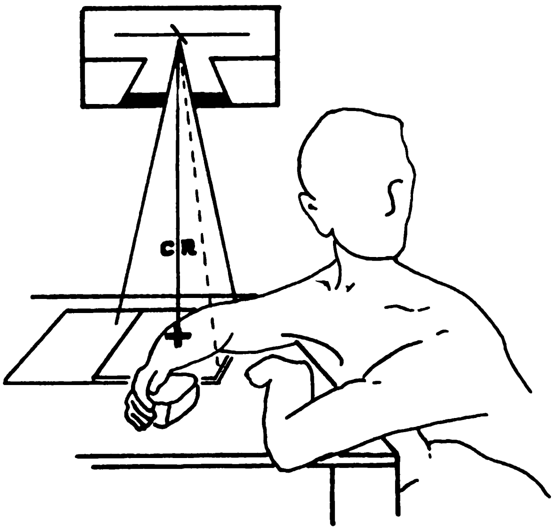


Figure 16A. Lateral of the right forearm.

The term lateral designates a side view of the part. For the extremities, "right" or "left" denotes the extremity to be X rayed.

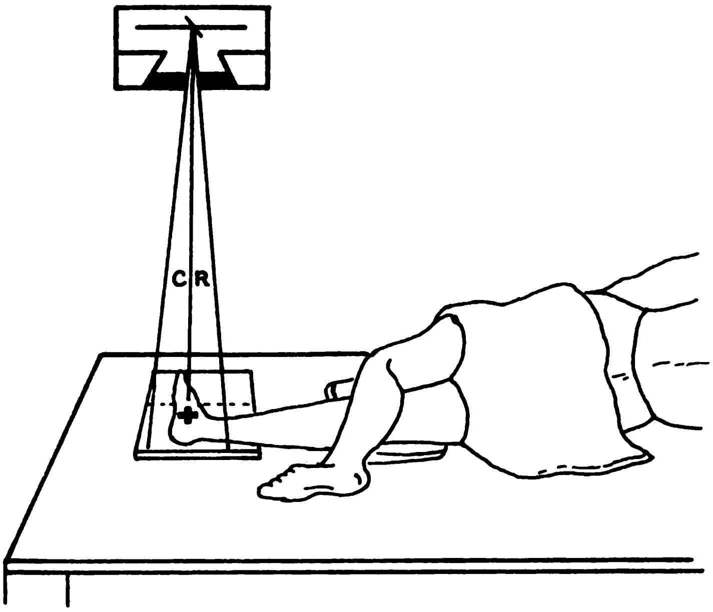


Figure 16B. Lateral of the right foot.

LATERAL

When referring to the axial skeleton, particularly the vertebral column, the ribs, and the sternum, right or left lateral refers to the side of the body neares the film.

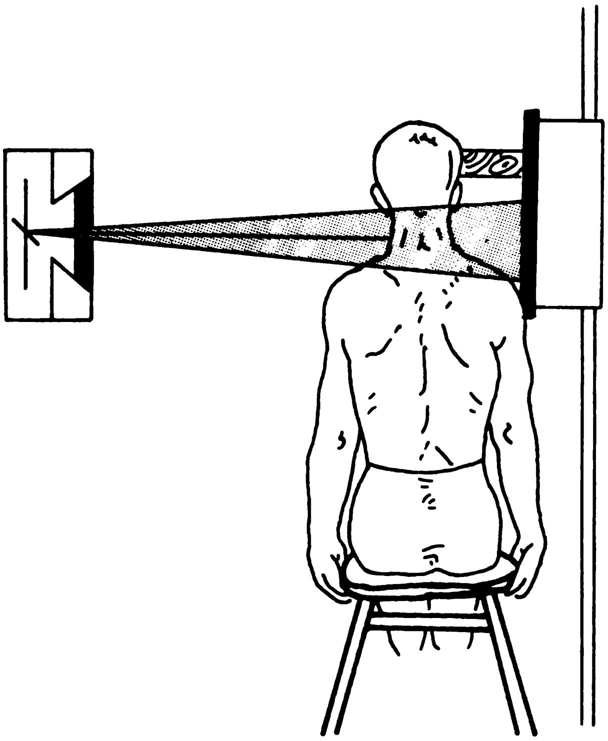


Figure 17A.
Cervical spine: right lateral.

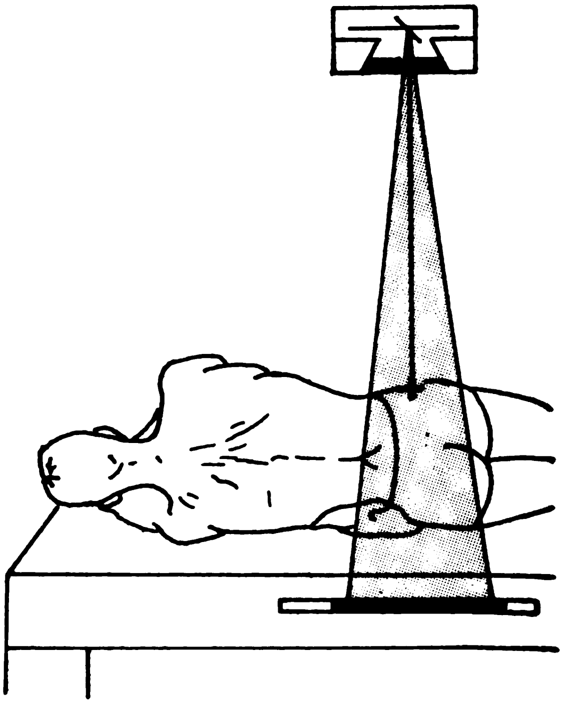


Figure 17B.
Lumbar spine: left lateral.

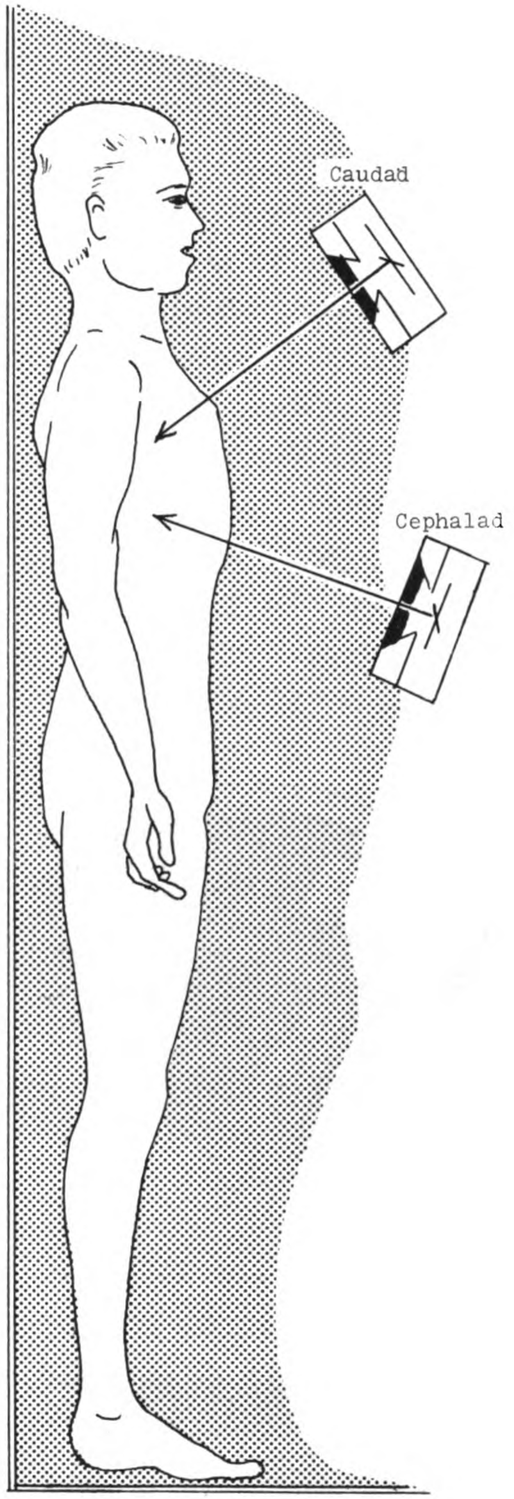


Figure 18.
Angulation of X rays.

ANGULATION OF X-RAY BEAM

Cephalad and caudad are two words used to describe the direction of the X ray beams when the X rays are to be directed at an angle. In cephalad angulation, the rays are angled toward the head or upper portion of the body (no matter what portion of the body is being X rayed). In caudad angulation, the rays are angled toward the feet or lower part of the body (no matter what part of the body is being X rayed).

CEPHALIC ANGULATION

The beam or central ray is angled toward the patient's head.

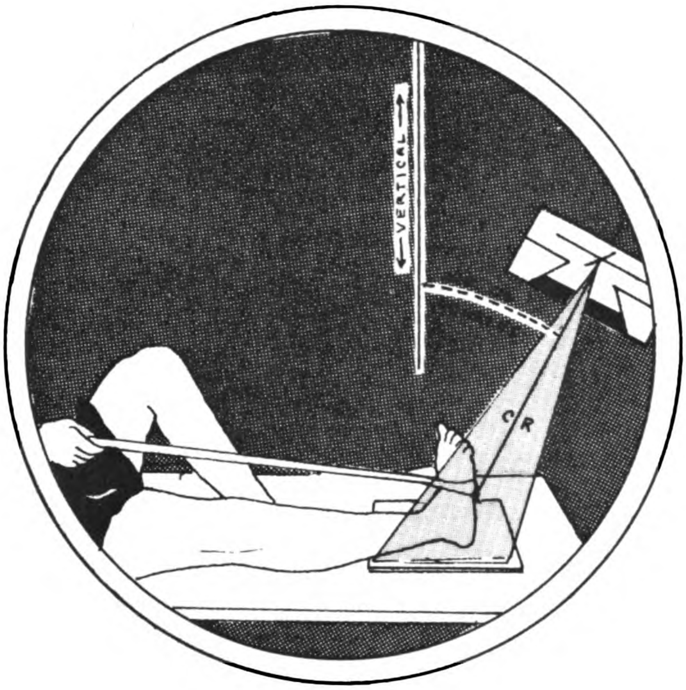


Figure 19A.
Cephalic angulation: the beam or central ray is angled toward the patient's head.

CAUDAL ANGULATION

The beam or central ray is angled toward the feet of the patient.

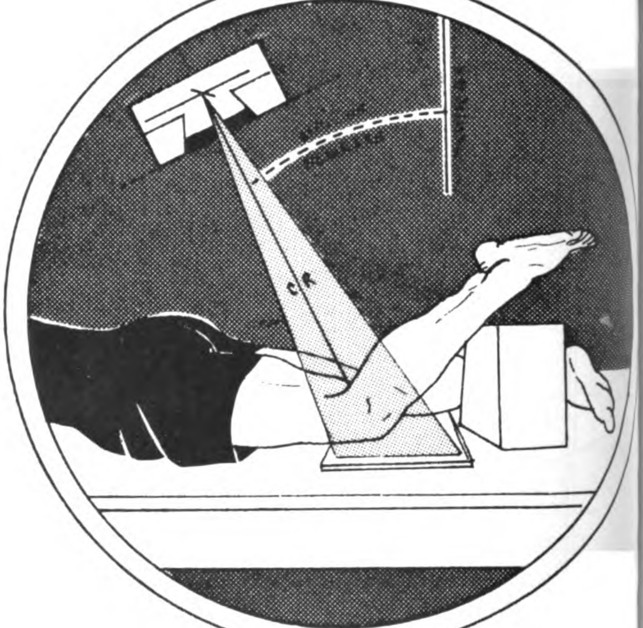


Figure 19B.
Caudal angulation: the beam or central ray is angled toward the feet of the patient.

EQUIPMENT

FILM, FILM HOLDERS, CASSETTES AND INTENSIFYING SCREEN

Images produced by X rays can be made visible in two ways: (1) a transient image produced on a fluorescent screen, and (2) a lasting image on a special light-sensitive film. We are concerned here only with the image produced on the film. The finished product is called a radiograph.

Since the film used to produce the radiograph is light sensitive, that is, it is sensitive to ordinary day light, it will be ruined if exposed to light before the developing process is complete. The film must be handled in complete darkness or by using the correct safelight. To maintain proper conditions while the film is being handled in the X-ray room and while the exposure is being made, the film is kept in a light-tight holder. The design of these holders varies from a simple, flexible, plastic-covered device to relatively heavy, sturdy, metal cases fitted with hinged or pressure lock covers. The sturdy metal film-holding devices are intended to be used with intensifying screens and films sensitive to light emitted by the screens. This type of film holder is called a cassette, while the simple type is referred to only as a film holder.

The film holder is intended for use with direct exposure (non-screen) film. Non-screen film is more sensitive to direct X-ray exposure and should never be used with screens. Non-screen film in a film holder is only suitable for use when X raying small parts (extremities less than 12 centimeters in thickness).

The intensifying screens make it possible to obtain an image on the film in a shorter time, and, therefore, with less exposure than is possible with X rays alone.

To minimize exposure and to avoid troubles due to involuntary motion, exposures are made on cassettes with screens.

There is a variety of intensifying screens available. Their speed normally depends upon the size or quality of the phosphor crystals. Fast screens provide high intensification. Slow screens provide better image sharpness. Medium speed screens provide a balance between speed and definition.

The intensifying screen is made up of a layer of tiny phosphor crystals, mixed with a binder and coated in a smooth layer on a cardboard or plastic support. A diagram of a cross section of the intensifying screen and of the cassette is show in Figure 20. In use, two screens are used in a cassette, one on each side of th film, which has a coating of emulsion on each side. This sandwich, or package, is enclosed in the metal cassette. The screens and the film must be under slight pre sure to insure close and uniform contact over the entire surface of the film. Fil that is not in close contact with the screen surface produces a slightly fuzzy ima

During the exposure, the X radiation passes from the X-ray tube, through the body part, through the front of the cassette, and is partly absorbed by the screen The energy of the radiation absorbed by the screens causes them to produce light. The intensity of the light produced by the screen is proportional to the amount of X radiation that passes through the body part and reaches the screen. Thus, over the entire surface of the screen, differences in X-ray intensity are transformed into differences in light intensity to which the film is highly sensitive. The light produced on the screen exposes the film and produces the image that becomes the radiograph when the film is developed. An exposure with intensifying screens requires only about 1/15 to 1/40 of that required for direct exposure to X rays without intensifying screens.

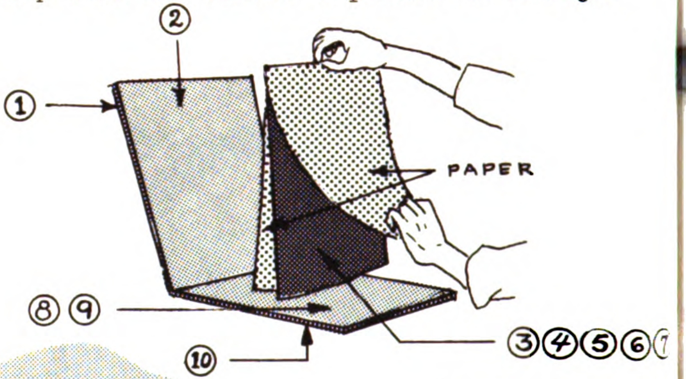


Figure 20A.
The cassette.

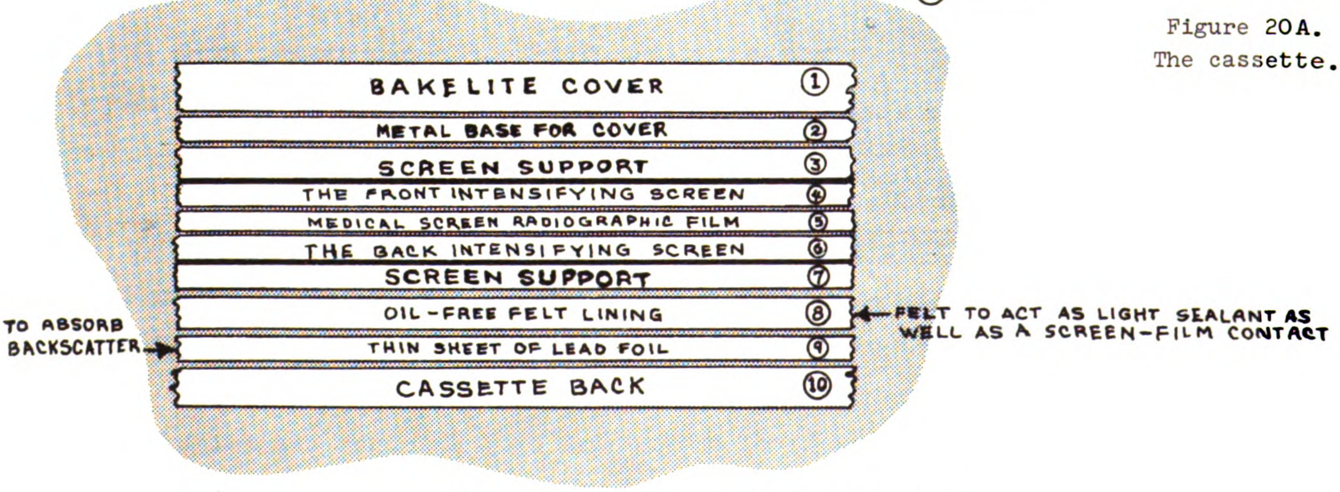

BAKELITE COVER ①
METAL BASE FOR COVER ②
SCREEN SUPPORT ③
THE FRONT INTENSIFYING SCREEN ④
MEDICAL SCREEN RADIOGRAPHIC FILM ⑤
THE BACK INTENSIFYING SCREEN ⑥
SCREEN SUPPORT ⑦
OIL-FREE FELT LINING ⑧
THIN SHEET OF LEAD FOIL ⑨
CASSETTE BACK ⑩
TO ABSORB BACKSCATTER
FELT TO ACT AS LIGHT SEALANT AS WELL AS A SCREEN-FILM CONTACT

Figure 20B. Cross section of cassette.

IDENTIFICATION MARKER: information pertaining to: (1) patient's name; (2) doctor's name; (3) patient's identifying number; (4) part of the body to be X rayed.

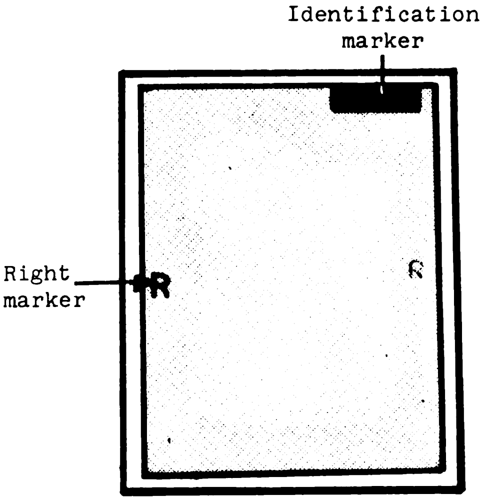


Figure 21A.
Cassette (front).

CASSETTE: device for holding X-ray films during exposure. Cassettes are made in several sizes. The side toward the X-ray tube is composed of bakelite, or other radiolucent substance, and the back side contains a thin lead sheet. The back is hinged and fits into the tube side, sealing out all light. Two intensifying screens are mounted inside, one on each side, between which the film is sandwiched. (Figure 21)

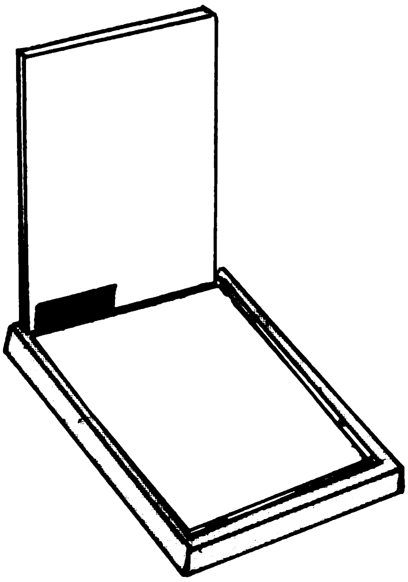


Figure 21B.
Cassette (open).

INTENSIFYING SCREENS: a dehydrated emulsion of certain chemicals (usually calcium tungstate) which fluoresces in the presence of X rays.

X-RAY TUBE

Modern X-ray tubes consist of three essential parts: an evacuated glass envelope, a hot-filament cathode, and an anode with a suitable metal target.

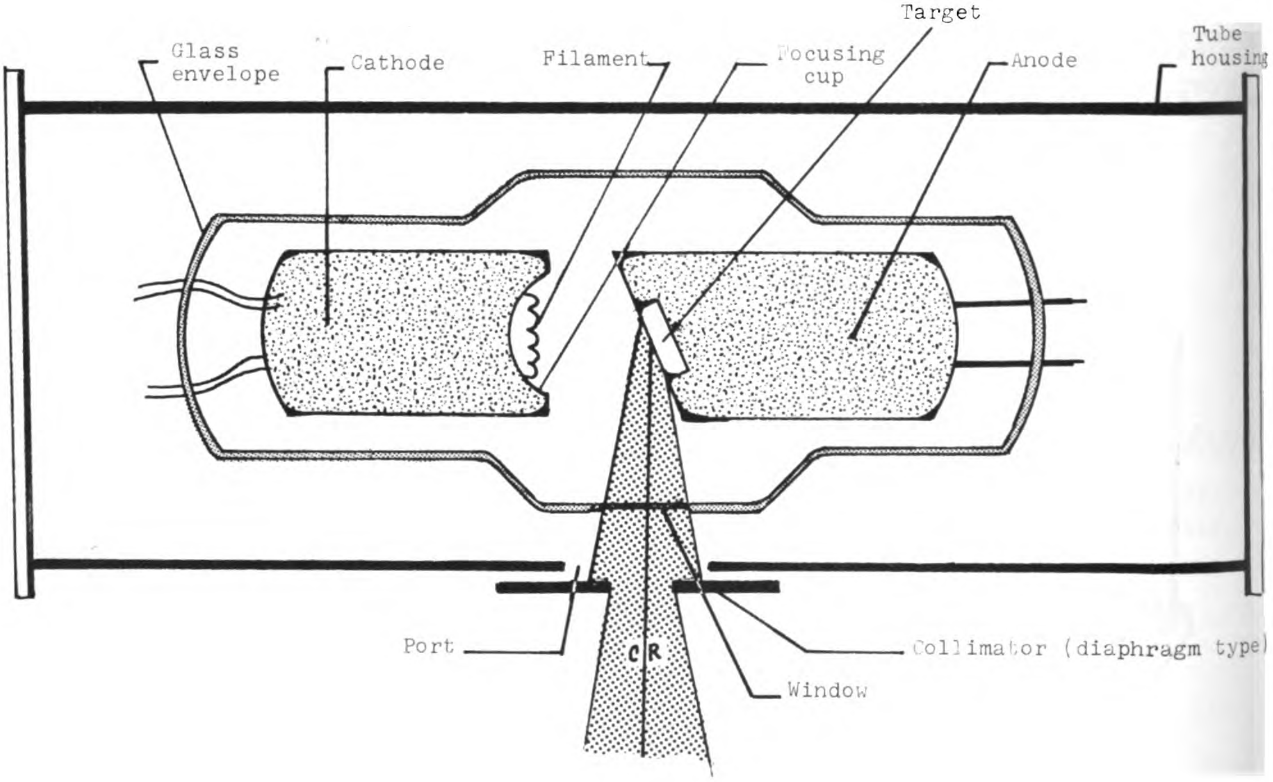


Figure 22. X-ray tube.

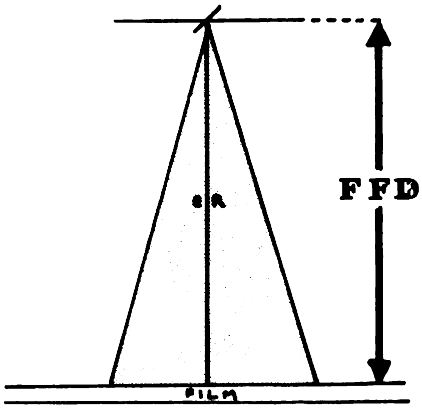


Figure 23A. Central ray.

THE CENTRAL RAY (CR)

This term designates the center of the bundle of primary X rays coming from the X-ray tube. The X-ray tube should be directed so that the central ray is directed at the center of clinical interest. The central ray concept is important because it is at this point that the resulting contrast and sharpness in the radiograph is greatest. The farther we get from the point of impact of the central ray, the less sharpness and contrast we find. See Figure 23B.

THE FOCAL-FILM DISTANCE (FFD)

This term refers to the distance from the X-ray tube target to the film. In most extremity and musculoskeletal radiography, the FFD is 40 inches, as shown in Figure 23A. The focal-film distance is also referred to as the TFD, or as the target-film distance.

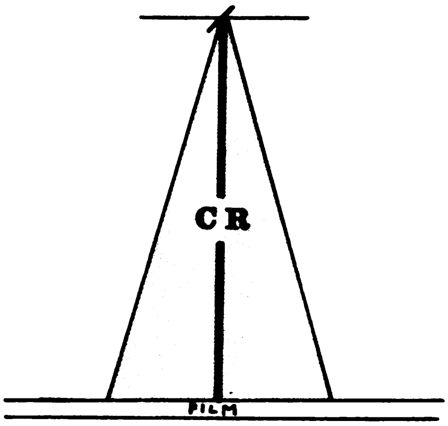


Figure 23B. Focal-film distance.

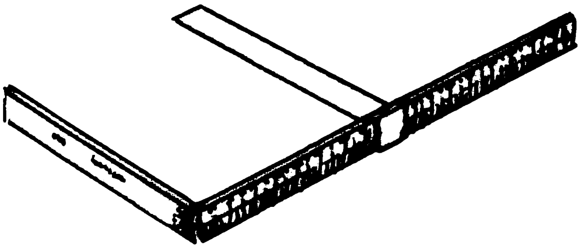


Figure 23C. A caliper.

THE CALIPER

The caliper is an instrument for measuring the thickness in inches or centimeters of a body part to be X rayed. See Figure 23C.

BEAM LIMITING DEVICES

COLLIMATORS, DIAPHRAGMS AND CONES

The collimator is a mechanical device with a variable aperture for restricti and shaping the X-ray beam to the area of clinical interest. The principal reaso for the use of the collimator is protection of the patient and the operator agai unnecessary exposure to X rays, but its use also improves the quality of the radiograph.

The collimator in its simplest form consists essentially of a lead washer or diaphragm having an aperture in the center, placed just below the window of the X-ray tube. It is not adjustable. For this reason, the lead washer should be used only on single purpose machines, using one film size and one distance such as: photofluorographic (mini-film machines) and dental units. If a machine is to be use for more than one procedure involving several film sizes and varied distances, ch and extremities for example, changeable cones or preferably a variable rectangula collimator with a beam-centering device must be used which will restrict the X-ra beam to the area of clinical interest.

Cones, as shown in Figure 24, are available in various sizes and shapes. Ea individual cone has a built-in lead washer collimator and is designed to produce a X-ray field of specific size and shape at a particular target-to-film distance. Since the cone fits onto the outside of the tube head, it can be changed whenever different size field is required. Thus, irrespective of what X-ray procedure is used, by using the appropriate cone, the field can be adjusted to the area of clinical interest.

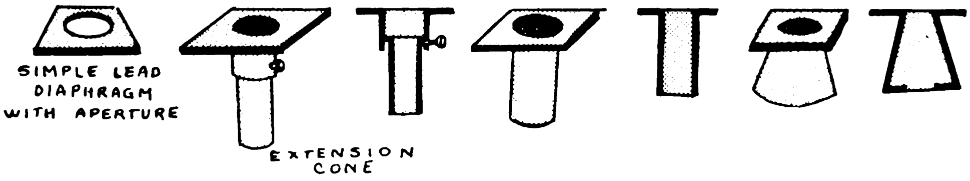


Figure 24. Lead diaphragm and cones.

Rather than change cones for each procedure, a variable collimator can be used. Most collimators are generally provided with calibrated scales to permit adjustment f the apertures for films of various sizes at different target-to-film distances. Some also have built-in controls which automatically adjust the collimator to produce a field exactly the size of the film being used. Most collimators are equipped with an illuminated beam-centering device of some sort and some have a lighting system which projects a beam of light outlining the area the X-ray beam will cover.

From the public health point of view, the variable rectangular collimator is the most desirable choice. It benefits the patient because each exposure can be tailored to fit the area of clinical interest; it reduces the scatter radiation the operator can receive. Because of the reduction of scatter radiation, it produces a sharper radiograph.

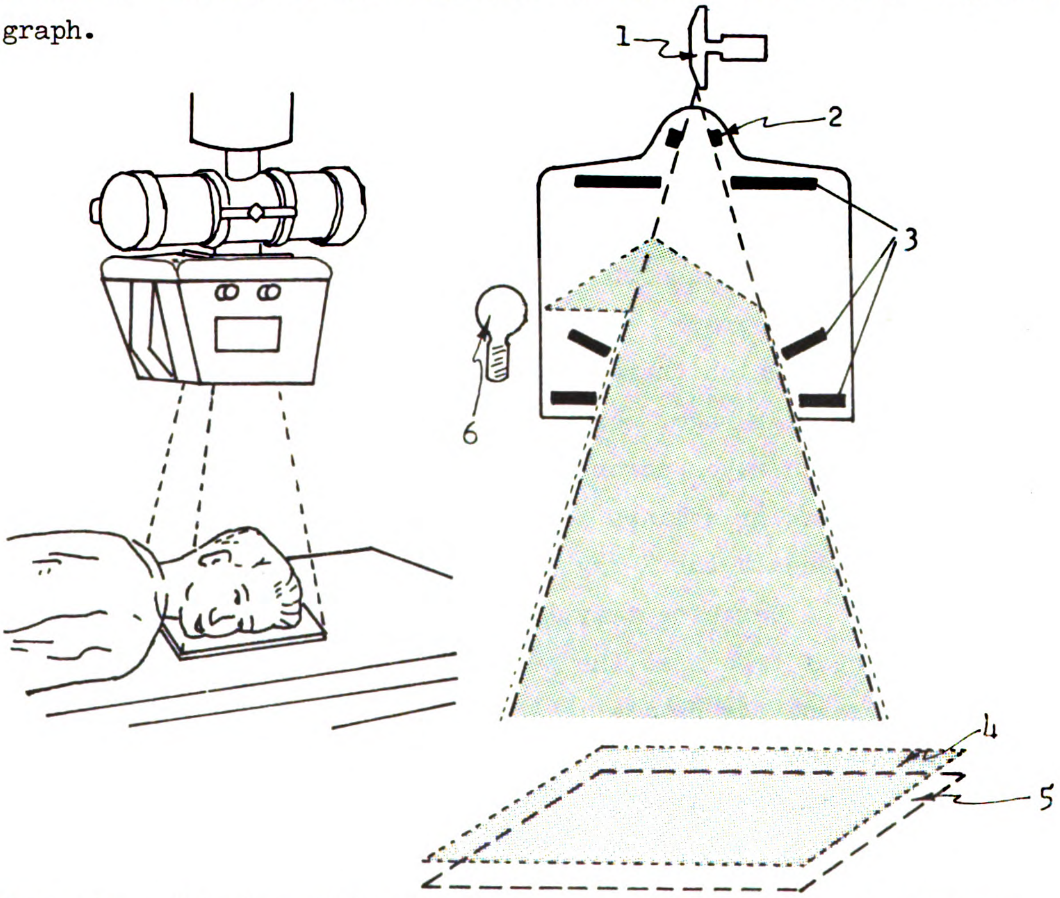


Figure 25. Principle of the light-beam variable diaphragm. 1. Anode of X-ray tube. 2. Lead-diaphragm. 3. Several lead diaphragms together forming the depth diaphragm. The light is reflected by a flat mirror in such a way that the beam of light appears to be coming from the focus. The beam of X rays then corresponds exactly to the beam of light. 4. Light-area. 5. X-ray area. 6. Light source. For the sake of clarity the light beam is shown separate from the field of radiation. Excerpted from Medical X-Ray Techniques by G. J. Van Der Plaats; with permission of McMillan, London and Basingstoke, and with the cooperation of Charles C. Thomas, publisher, Springfield, Illinois.

GRIDS: STATIONARY AND MOVABLE

When X rays penetrate the human body, a small amount is diverted by the tiss structure, resulting in X rays moving about in many directions. This is referred as secondary or scatter radiation. Some of these rays reach the film resulting low contrast due to undesirable darkening, fogging and lack of sharpness. To red the effects of secondary radiation, and to improve contrast and sharpness, a devi known as a grid is used.

A grid is a stationary arrangement of thin lead strips interspaced with a ra iolucent material. The purpose of a grid is to remove (absorb) a considerable qu tity of secondary (scatter) X radiation, which causes unnecessary density in the radiograph. A grid is used when the use of a Bucky is either impractical or impossible. Lysholm and Waifer are common names of grids.

Since the lead strips absorb the rays that strike them, shadows (grid lines) will appear on the radiograph. A fine-lined grid, used properly, will help produ high quality films on which these lines are barely visible.

A Potter-Bucky diaphragm, commonly called a Bucky, is an arrangement of lead strips in a grid which moves across the short axis of the X-ray table. This movement prevents the lead grid lines from being demonstrated on the radiograph.

The Bucky is beneath the X-ray table top and moves a flat grid across the sho axis of the table. A cassette tray is below the grid and the entire device is placed upon a pair of tracks so the device can be moved the length of the X-ray table. The purpose of the device is to facilitate radiographic exposure of thick and/or dense anatomical parts and to decrease the scatter or secondary radiation that strikes the film. As a result, a Bucky improves detail visibility and contrast.

Use of either a stationary or a moving grid absorbs some of the X rays and, as a result, the exposure must be increased.

Fig. 26A: Diagram of a Potter-Bucky diaphragm. In practice, a cone is also used to constrict the beam, and thereby lessen the amount of secondary radiation produced. Fig. 26B: Diagram of a small section of a grid showing how a large proportion of the scattered radiation is absorbed, and image-forming radiation passes through to the film.

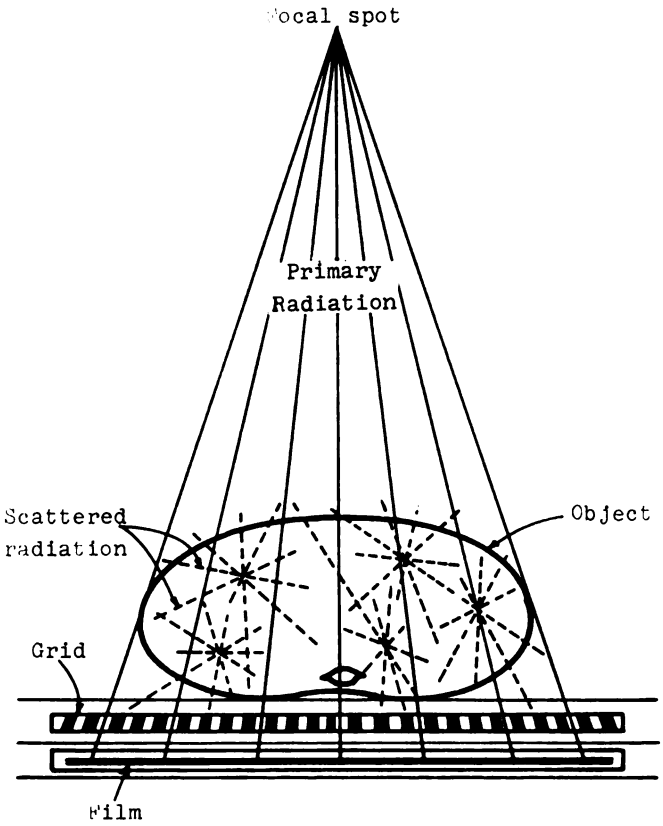


Figure 26A.

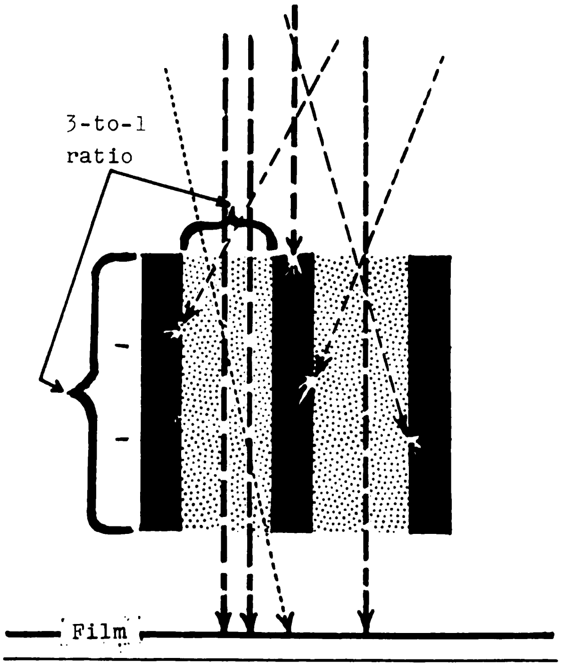


Figure 26B.

● Lead grid strip

○ Radiotransparent strip

······ Unabsorbed scatter radiation

——· Absorbed scatter radiation

▬▬ Primary radiation

STATIONARY GRID: device which consists of a series of alternate radiopaque and radiotransparent strips, deeper than wide, which--when interposed between patient and film--allows primary rays to pass through the radiotransparent strips, but the secondary radiation is absorbed by the radiopaque strips. The efficiency of a grid ranges from 85 to 95 percent in the elimination of secondary radiation, thereby enhancing contrast and increasing detail visibility.

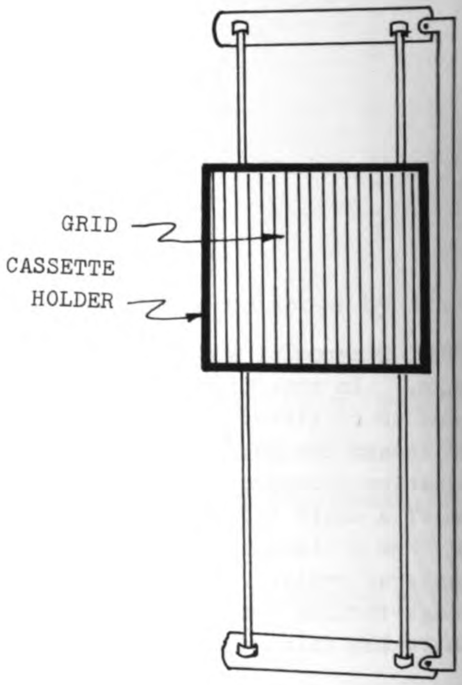


Figure 27A.
Grid in cassette.

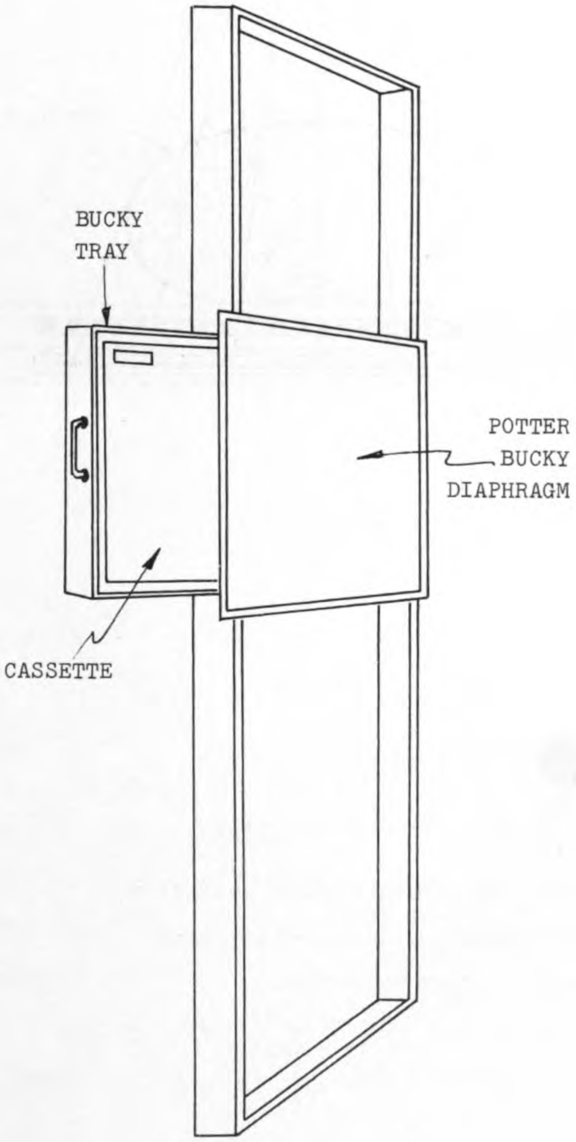


Figure 27B.
Potter-Bucky diaphragm.

BUCKY DIAPHRAGM (Potter-Bucky diaphragm): device used in radiography consisting of a movable grid of lead strips so arranged as to reduce the effect of secondary radiation on a radiograph.

BUCKY TRAY: sliding metal tray beneath the table top and grid for placing a cassette beneath the part to be examined.

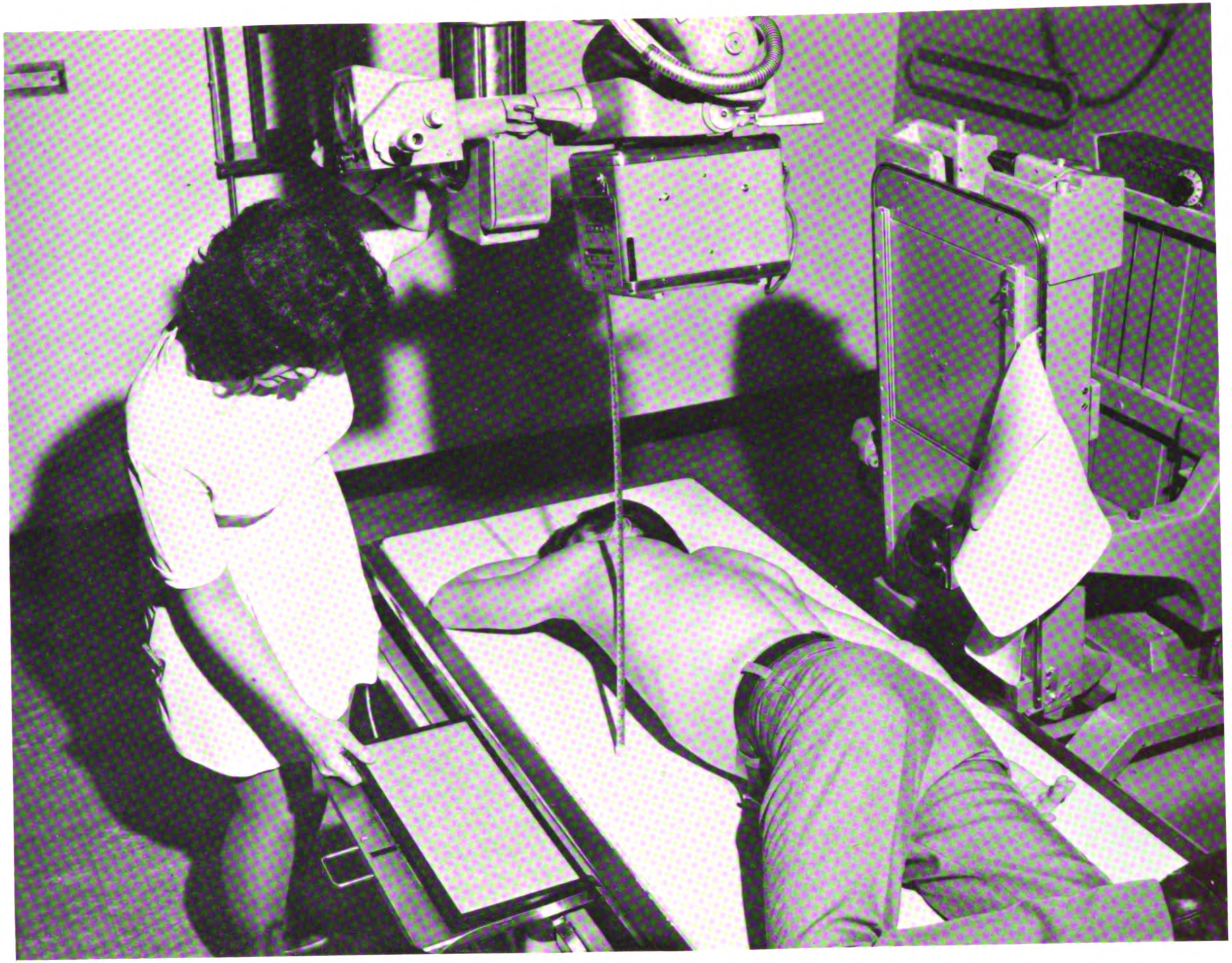


Figure 28. The X-ray room.

CHAPTER II

THE RADIOGRAPHIC ROUTINE

THE RADIOGRAPHIC ROUTINE

Method of Approach

To produce a satisfactory radiograph, the technician must develop a step-by-step routine for taking an X ray. Into this routine, he must incorporate those deviations which are necessary for X raying the individual patient -- the average, the obese or muscular, the young or old, the emphysematous or otherwise diseased, etc. A well-planned routine will help the technician perform more efficiently to produce films of a better diagnostic quality.

The following general outline can serve as a guide to help the technician develop his own step-by-step extremities radiographic routine.

A. Preliminary preparations.
   1. Determine the part and number of views the doctor has requested.
   2. Make up the patient's identification marker. Include pertinent information, as:
      a. patient's name
      b. patient's identification number
      c. patient's age
      d. doctor's name
      e. the date
      f. any other information required.

B. Prepare the patient.
   1. Ascertain that all clothing and other foreign objects have been removed from the part to be examined and that the gown, if used, is being worn properly with the opening at the back and with no knots or strings covering the area of clinical interest.
   2. Inform the patient about what is going to be done and explain what the patient must do.

C. Prepare the machine and the film.
   1. Measure with a caliper the part thickness which will be X rayed.
   2. Consult the technique chart and determine the technical factors which must be used.
   3. Set the control panel.
   4. Adjust the collimator or select the proper cone.

5. Set the focal-film distance (FFD) to 40 inches unless some other di tance has been specified.
6. Select the cassette or film holder to be used.
7. Put the identification data on the cassette.
8. Place either a right or a left marker on the cassette or film hold
9. Move the cassette to the correct position for the part being X ray
10. Center the central ray (CR) to the cassette.

D. Position the patient.
   1. If necessary, fix the immobilization aids.
   2. Make the necessary final adjustments of the cassette and central r (CR).
   3. If necessary, apply a protective leaded apron or other protective d vice on the patient.

E. Make the exposure.
   1. Step behind the leaded protective barrier.
   2. Give the patient the final instructions (not to move and to take a deep breath).
   3. Make the exposure.
   4. Tell the patient to relax and breathe normally.
   5. If necessary, exchange the cassette and continue with the next vie Should no further exposures be necessary, direct the patient to th appropriate waiting area.
   6. Put the cassette in the passbox leading to the darkroom and begin the examination of the next patient, or develop the film in the darkroom.

More information about the patient, the patient's position and the X-ray machine follow.

The Patient

Before an X ray can be taken, the technician should instruct the patient to remove all clothing from the part to be X rayed. If rings, wristwatches, and ot jewelry are worn on the part to be examined, they should be removed. If an injur finger is swollen and the patient says that he or she cannot remove the ring, do try to remove it yourself. If the part to be examined is the foot or ankle, the appropriate stocking and shoe should be removed.

Caution: when a patient comes into the office wearing a splint, heavy bandages r a sling, do not remove them yourself. If your supervising physician does not emove these articles, take the X rays through the splint or bandage.

When necessary, both male and female patients will be dressed in a hospital own. The opening of the gown should be at the patient's back, with the tie strings oosened in the area of exposure. Starch should not be used in the gowns, as starch may cast shadows on the film.

The technician must be sure that the pockets of the gown are empty and that the patient's eyeglasses are removed. This should be done even though the pockets and yeglasses will not be in the area of exposure. If necklaces, earrings, bracelets or other foreign metallic objects are in the area of clinical interest, they should also be removed to prevent possible interference with the radiograph. If such items are not removed, the angulation of the central ray may project them into the clinical interest areas and create on the film the illusion of diseased tissues.

Before asking the patient to lie on the X-ray table, the technician should inform the patient about the position in which he will be filmed. Instructions should be short, simple and clear. If a special breathing technique (deep expiration, etc.) is required, the patient should understand beforehand what is expected of him. If necessary, the technician should demonstrate the breathing technique.

When necessary, the technician can assist the patient onto the X-ray table. However, it is best to let the patient do as much of the moving as is safe and reasonable. Wheelchair and guerney patients require very careful handling. Before moving a seriously injured or helpless patient, the technician should always be sure a sufficient number of people are available to help. The technician should never try to lift a helpless patient alone. Should there be any question about the movement of a seriously injured patient, the technician must seek the advice of a physician or qualified nurse. Before moving a patient to or from a wheelchair, the technician should always check to see that the wheels are locked in place and that the wheelchair will not move while moving the patient.

Radiography of infants and children presents special problems. Because young people may not be cooperative, the technician must give more attention to the motion factor. It may be necessary to watch the child until a period of calm occurs. Make use of immobilization aids, such as sandbags, compression bands, sponges and brat board. In cases where immobilization aids cannot be used, it may be necessary, in the case of an uncontrollable child, to hold the patient. In such cases, sc one who is not usually exposed to radiation, such as a member of the patient's f ily, should be used. A pregnant woman should never be used for this purpose. T person assisting must be provided with a leaded apron and leaded gloves to wear ing the exposure.

It is the technician's responsibility to see that every film is properly ma with the patient's identifying information and appropriately labeled as to eithe the right or left side of the body. Commercially manufactured markers are avail

The Machine

Every X-ray department should have a technique chart at each X-ray machine. This chart should show all the techniques which are employed. It should also sh the recommended kVp, mAs values and distances to be used, based on specific body measurements. A suggested starting technique is listed at the bottom of each pr jection in the following pages on positioning. Charts for each machine are usua supplied by the X-ray company that provided the machine. Periodic adjustments s be made on this chart to insure the production of quality diagnostic films.

The technician must carefully evaluate all the patient's factors such as th ness of the body part, age of the patient, condition of the patient, etc., befor carefully selects the kVp and mAs technical factors. In general, to decrease fil contrast, the mAs must be reduced and the kVp increased; to increase contrast, mAs must be increased and the kVp decreased.

Measurement of a body part thickness with a caliper should be made between t point of entry and exit of the central ray. In making the measurement, the blade of the caliper should barely touch the skin at the points of entry and exit. To guarantee a more accurate measurement, it should be made with the patient in the position in which the exposure will be taken. Measurements of any body part shou always be made before exposure.

In determining tissue opacity, the technician must consider not only the patient's age, but also his muscularity and obesity, etc. An obese person will be opaque to radiation than a muscular person, even though their measured thickness the same. Also, an older person is usually less opaque than a younger individual and the tissue opacity of infants is different from that of adults. To provide satisfactory contrast, the milliampere-second and kilovoltage should be decreased for infants, children, and aged.

In all cases where undesired motion is a factor, a short exposure time is recommended. For example, for infants the milliamperage and time of exposure must be alculated so that the exposure factor is adjusted to the shortest practical time.

Collimation must be used not only because it is required by law, but also because it will increase the film contrast and thus render a film of better diagnostic uality. The use of collimation is necessary to limit the X-ray beam to the area of linical interest.

Radiation exposure to the patient, the technician, and all others can be reduced considerably by using fast film. In addition to fast film, a cassette with high speed screens can be used. Most contemporary equipment will permit the technician to use exposure times as fast as 1/120th of a second, 1/60th of a second, 1/30th of a second, and so on. When X raying a child, regardless of the equipment and tube capacity, the technician should use technical factors based on exposure values no longer than 1/10th of a second. If the exposure value is greater, there will almost certainly be an objectionable loss of detail due to motion.

Immobilizing the Patient

Immobilization of a part being examined is very important. Loss of radiographic detail due to motion of the part can be avoided by proper immobilization. Immobilization bands (compression bands), sandbags and radiolucent sponges are used to minimize motion. The technician should place the immobilization devices just prior to making the actual exposure and remove them immediately after completing it. When dealing with patients suffering from nervous or mental disorders, it is sometimes advisable from a psychological viewpoint not to use immobilization devices.

Because of anatomical variations, the technician may have to change the position of the patient, the tube or the film. In some instances, the position of all three will have to be changed if best results are to be obtained. In extremity and musculoskeletal radiography, the focal-film distance is usually 40 inches.

CHAPTER III

THE SKELETON

THE SKELETON

The skeleton is formed of bones, supplemented in some areas by cartilage. There approximately 206 bones in an adult skeleton.

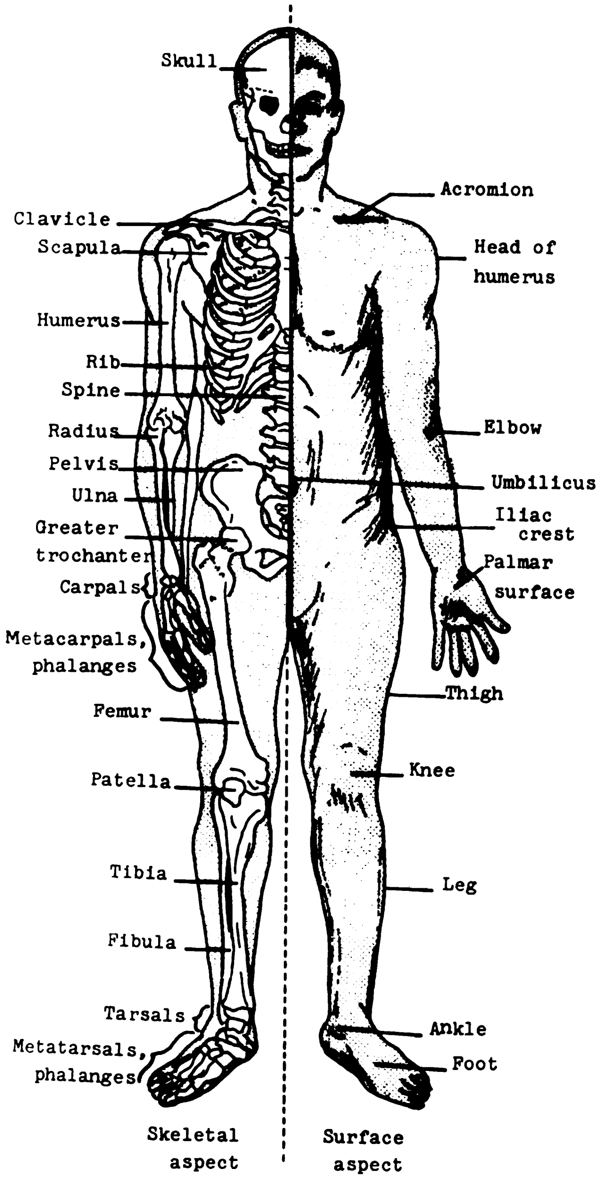


Figure 29A.
Skeleton, anterior view.

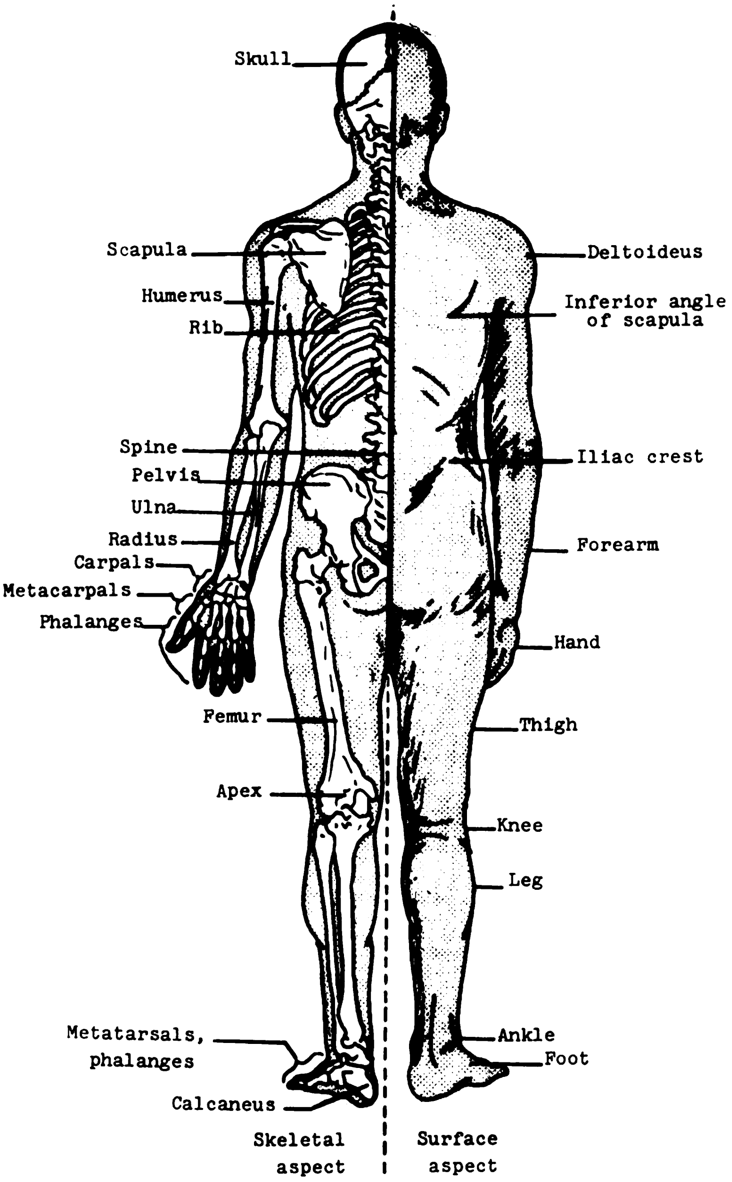


Figure 29B.
Skeleton, posterior view.

Bone Formation and Growth

All bones are formed by one of two methods:

a. Endochondral, or bone formation from cartilage, and

b. Intramembranous, or bone formation from fibrous membrane.

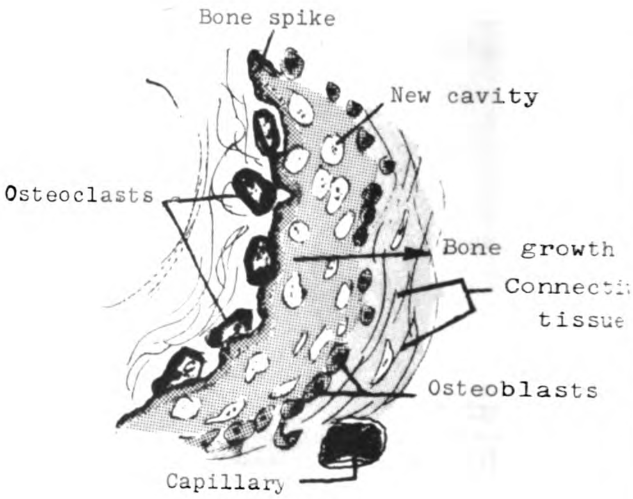


Figure 30.
Cross section of bone.

Bone Formation from Cartilage

The bones of the skeleton are preformed from cartilage.

Originally, a long bone is a mass of cartilage. Ossification centers are located in the extremities of the emerging long bone. The process of ossification starts from these ossification centers, which remain cartilaginous for some time. A similar ossification process begins in other places in the extremities and gradually proceeds toward the center.

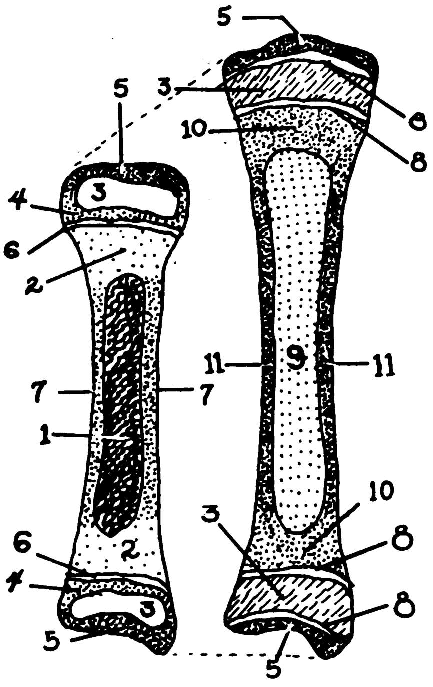
An area of cartilaginous tissue persists after birth for various periods of time. In infants and children, this area allows growth in length, and is called the epiphyseal zone.

velopment of Bones

Growth in length takes place in the epiphyseal zones, which are located in the tremities of the bone. The shaft is called the diaphysis and the end of the bone called the epiphysis. The time required for the bones to reach full development ries for the different parts of the skeleton.

The appearance of the epiphyseal centers of ossification, and their developnt, can be followed by roentgen examination. Some centers appear at birth while thers appear periodically during the first fifteen years of life. Later, the epiysis and shaft of the bone unite. All epiphyseal zones have usually united by e age of 25.

1	Marrow space
2	Calcified cartilage
3	Epiphysis
4	Epiphyseal cartilage
5	Articular cartilage
6	Cartilage growth
7	Diaphyseal bone
8	Epiphyseal lines
9	Marrow cavity and periosteum
10	Spongy bone
11	Compact bone



Developing bone.

Bone after cessation of growth.

Figure 31.

BONE FORMATION FROM FIBROUS MEMBRANE

Only the bones of the skull or cranium are formed from a fibrous membrane. Here, in various portions of the membrane, an ossification center develops. Fro these centers, tiny calcium spines radiate in all directions. Between the radia ing calcium (columns), the osteoblasts (bone-forming cells) construct the bone.

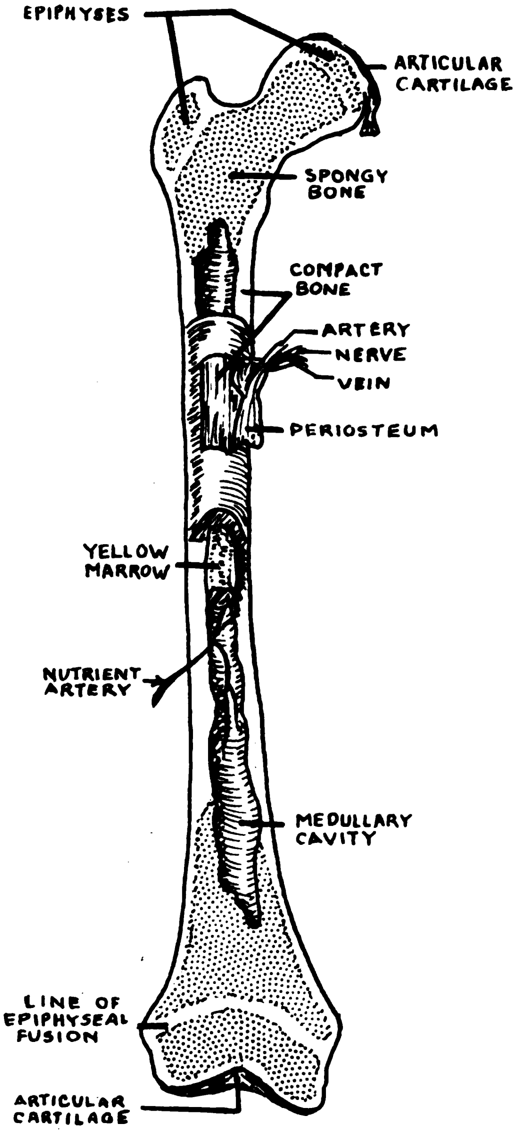


Figure 32.
Cross-section of femur.

BONE GROWTH

Bones are surrounded by a tough, fibrous membrane called the periosteum. The endosteum is the tissue lining the medullary (marrow) cavity of a bone.

The bone growth (an increase of the bone in diameter and length) takes place in the following way: the periosteum, which covers the bone, contains osteoblasts or bone-forming cells, whi deposit layers of bone to form the out portion of the bone. Together with the growth in diameter from the outer portion of the bone, osteoclasts, or bone-destroying cells, in the endosteum, destroy some of the bone internally. This action of the osteoclasts enlarges the internal (medullary) canal.

CLASSIFICATION OF BONES

The bones of the skeleton may be classified according to their shape. They are long, short, flat or irregular.

LONG BONES: found in the extremities. Each has a long, usually cylindrical shaft with two expanded extremities. The shaft is called the diaphysis. The two ends, the growth part of the bone, are called the epiphysis. Examples of long bones are the humerus, shown in Figure 33, and the femur.

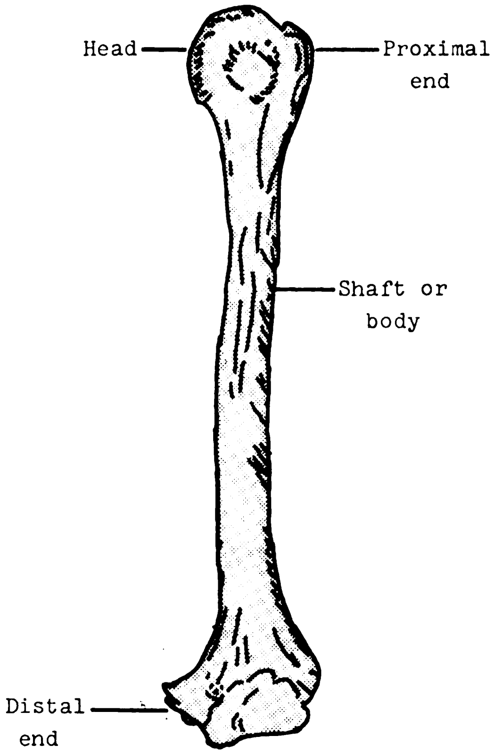


Figure 33.
The humerus.

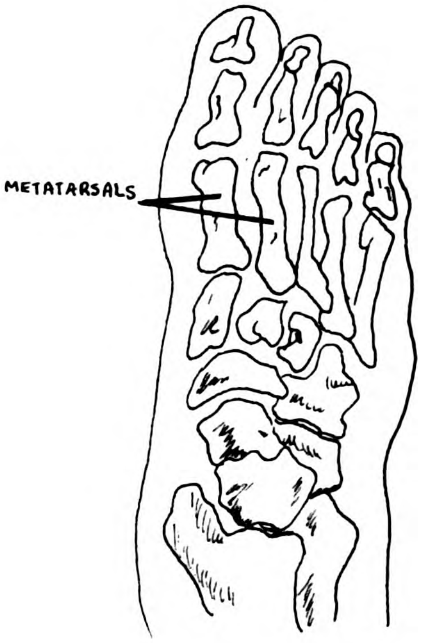


Figure 34A.
Anterior view of the foot.

SHORT BONES: cube-shaped; composed spongy bone enclosed in a thin shell compact bone. They are often short, indrical shafts with two expanded ext ities. They usually occur in groups. Examples of short bones (Figure 34A) the bones of the foot (the metatarsal bones).

FLAT BONES: two plates of hard, bony substance with a thin layer of spongy red marrow in between. The scapula, shown at right, is an example of a flat bone.

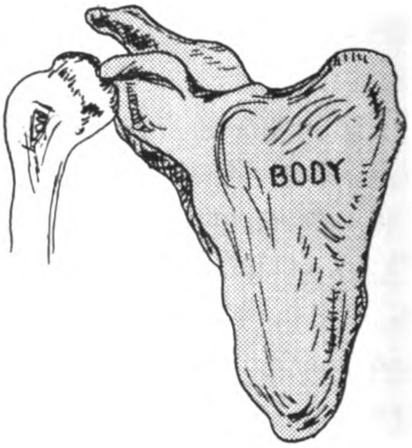


Figure 34B.
Anterior view of the scapula.

IRREGULAR BONES: bones whose size and shape are modified by their function and position. The vertebrae are examples of irregular bones (Figure 34C).

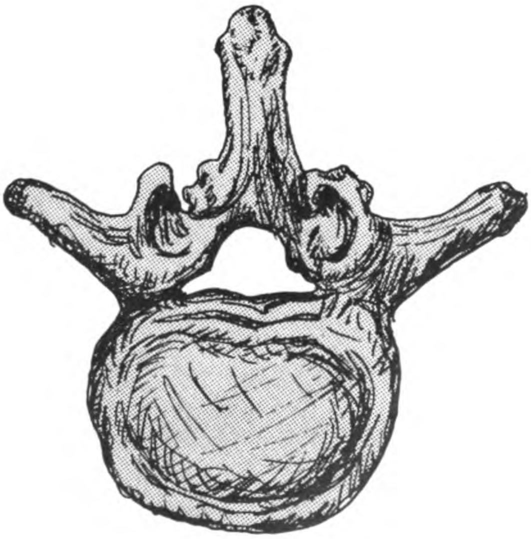
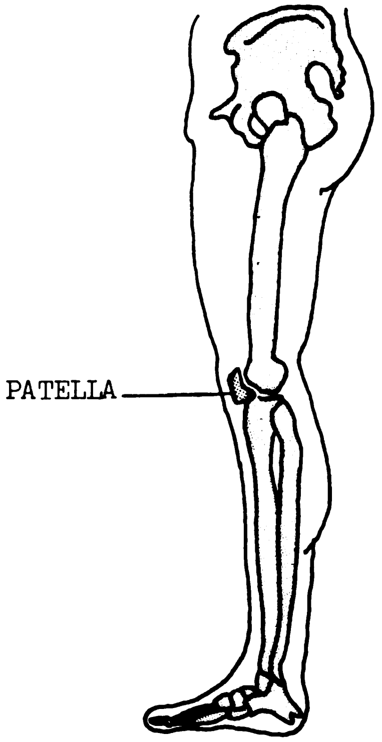
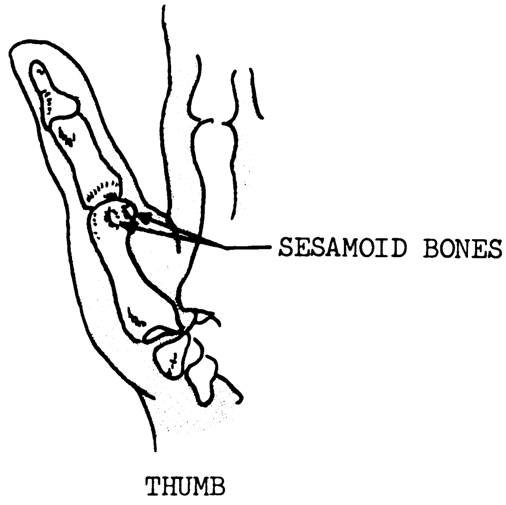


Figure 34C.
Typical lumbar vertebra.

SESAMOID BONES: small bones embedded in tendons which pass over the joints. In addition to lessening friction, they modify pressure, and help to protect the ligaments and tendons. Examples of sesamoid bones are the patella (knee cap) and those situated on the palmar surface of the metacarpal bone of the thumb See Figure 35.





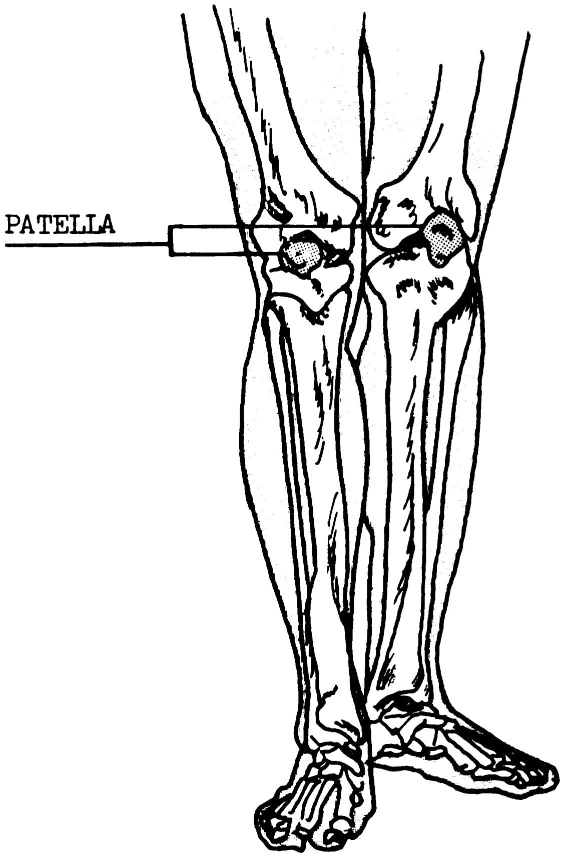
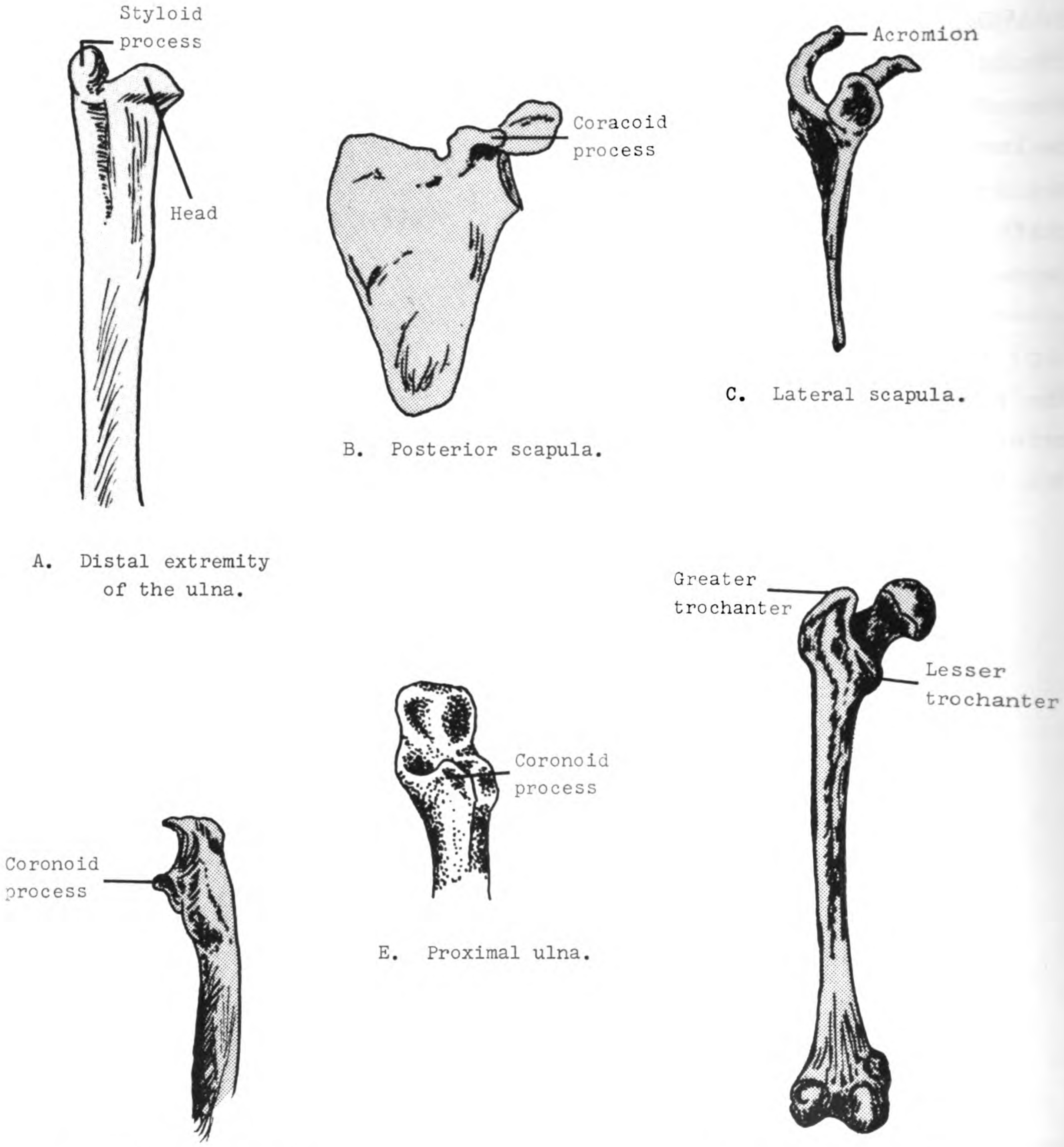


Figure 35. Examples of sesamoid bones.

PROCESS



A. Distal extremity of the ulna.

B. Posterior scapula.

C. Lateral scapula.

D. Proximal extremity of the ulna.

E. Proximal ulna.

F. Posterior aspect of the femur.

Figure 36. Process: a prominence or projection, as of bone. Illustrated are the styloid, coracoid, acromion, coronoid and trochanter processes.

EAD: the portion at the end of a bone, sually rounded.

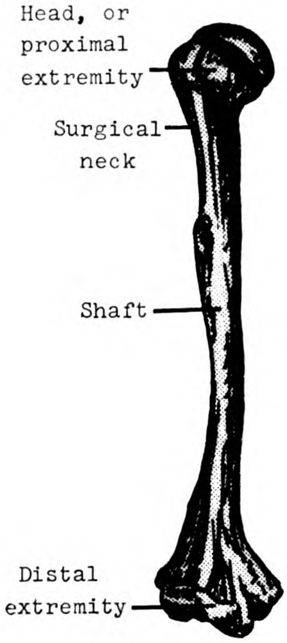
XTREMITY: the expanded end of a bone.

HAFT or BODY: the long, cylindrical art, or the principal portion of the one.

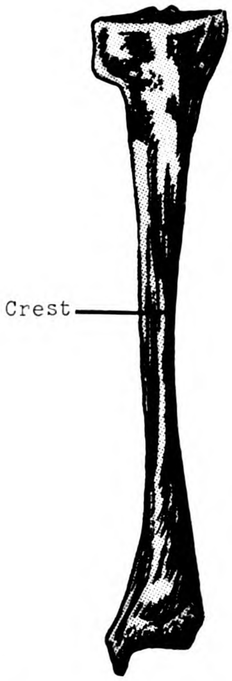
ECK: the constricted portion of the bone ext to the head.

REST: a projecting ridge of bone.

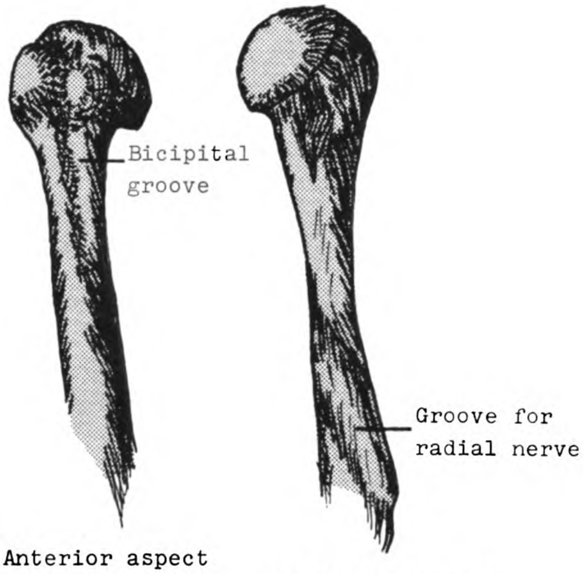
ROOVE (or SULCUS): an elongated depression on the surface of a bone; a furrow.



A. Right humerus, anterior aspect.



B. Anterior aspect of the tibia.



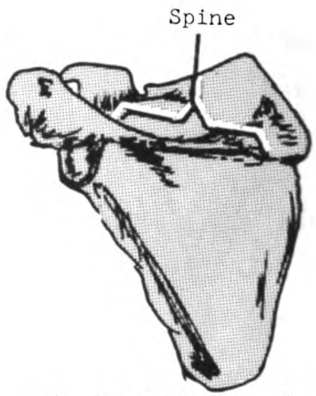
Anterior aspect

Posterior aspect

C. Proximal right humerus.

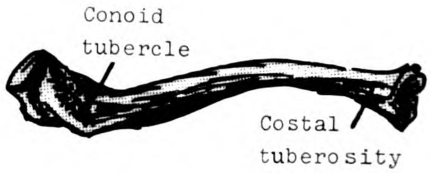
Figure 37. Terms relating to bones: head, extremity, shaft, neck, crest and groove are illustrated.

SPINE: a sharp projection.



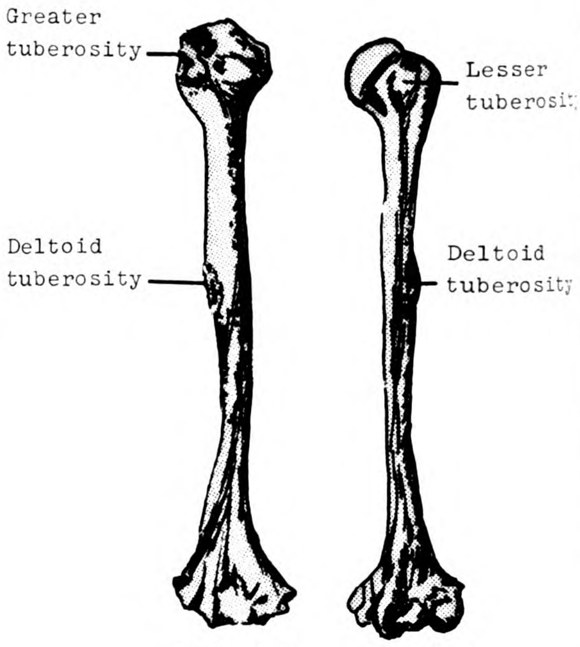
A. Anterior aspect of the scapula.

TUBERCLE: a small, rounded projection.



B. Inferior aspect of the clavicle.

TUBEROSITY: a large eminence (prominence or projection), usually roughened for the attachment of tendons and ligaments.

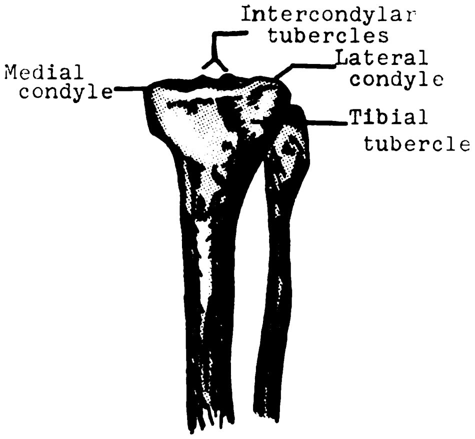


Posterior aspect

Anterior aspect

C. Left humerus.

Figure 38. Spine, tubercle and tuberosity bone classifications are defined.

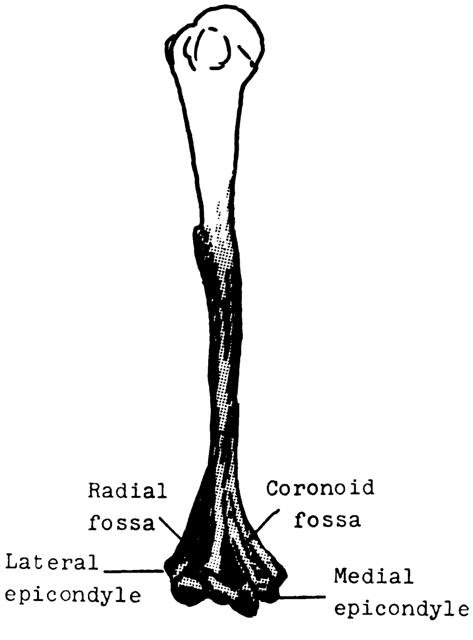


A. Anterior proximal tibia and fibula.

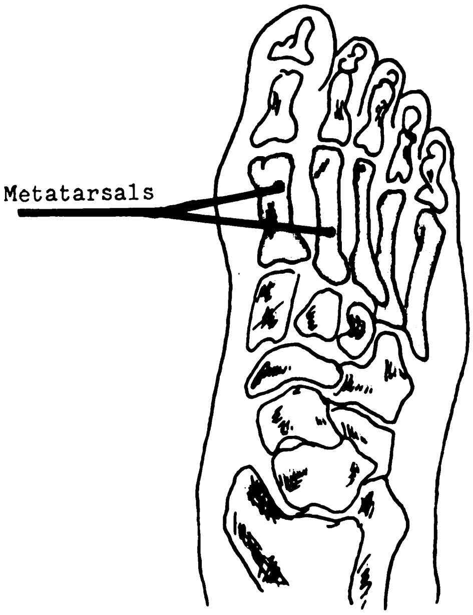
CONDYLE: a smooth, rounded swelling at the articular end of a bone. See Figure 39A.

EPICONDYLE: a small eminence of bone above the condyle, usually roughened. See Figure 39B.

BASE: the expanded portion at the end of a bone, opposite to the head. See Figure 39C.



B. Anterior aspect of the right humerus.

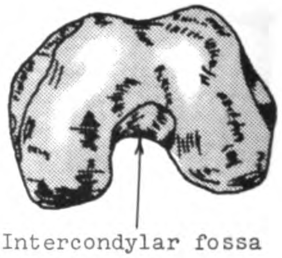


C. Metatarsals.

Figure 39. Condyle, epicondyle and base are bone terms, illustrated above and defined.

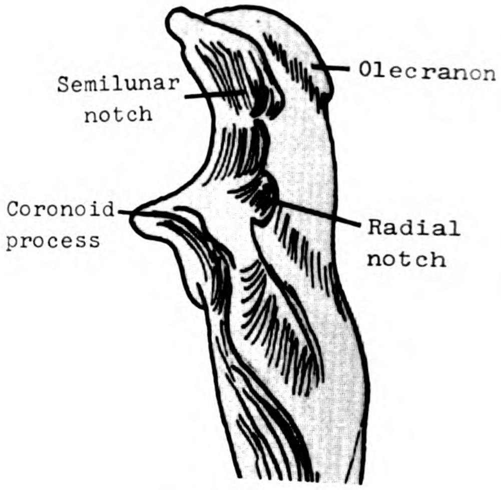
DEPRESSIONS FOUND ON BONES

FOSSA: a pit or open cavity (usually not for articulation).



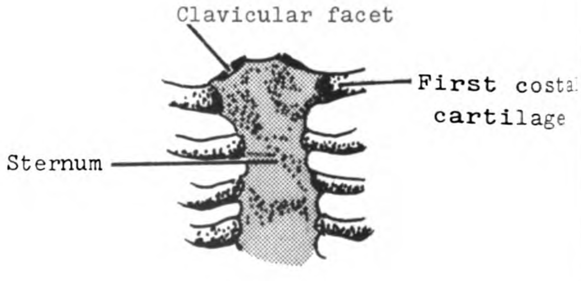
A. Inferior aspect of patella.

NOTCH: a deep indentation or narrow gap in the edge of a part.



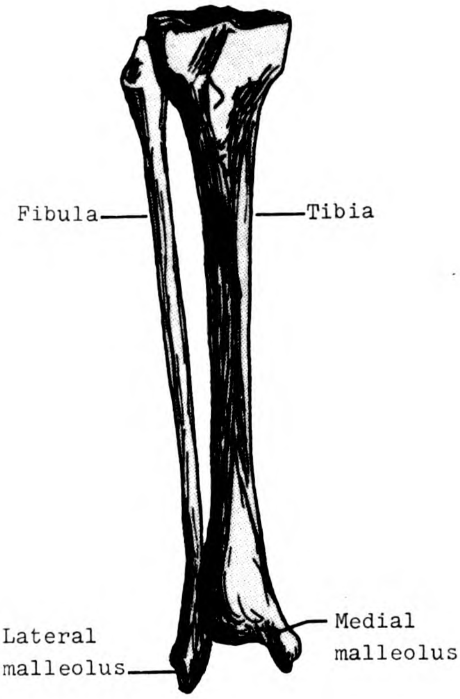
B. Proximal extremity of the ulna.

FACET or FOVEA: a smooth depression on the surface of a bone for articulation with another bone.



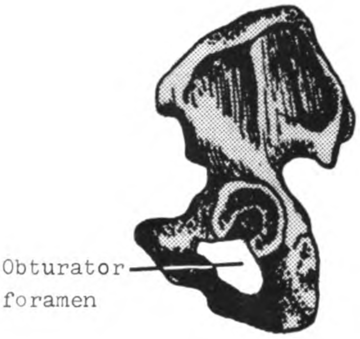
C. Sternum.

Figure 40. Bone classifications fossa, notch and facet are defined.



A. Anterior right lower leg.

MALLEOLUS: either of the two rounded prominences on either side of the ankle joint at the lower end of the tibia and fibula.



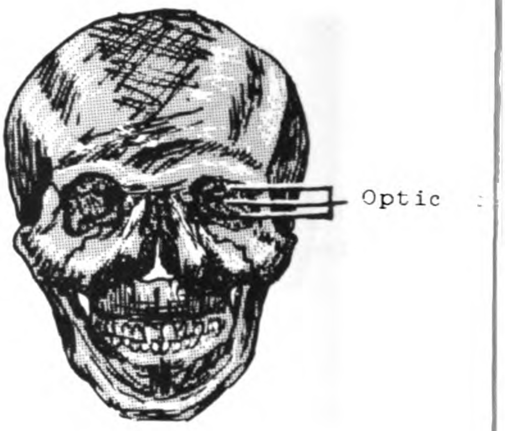
B. Lateral right pelvis.

FORAMEN: a hole or opening in the bone.

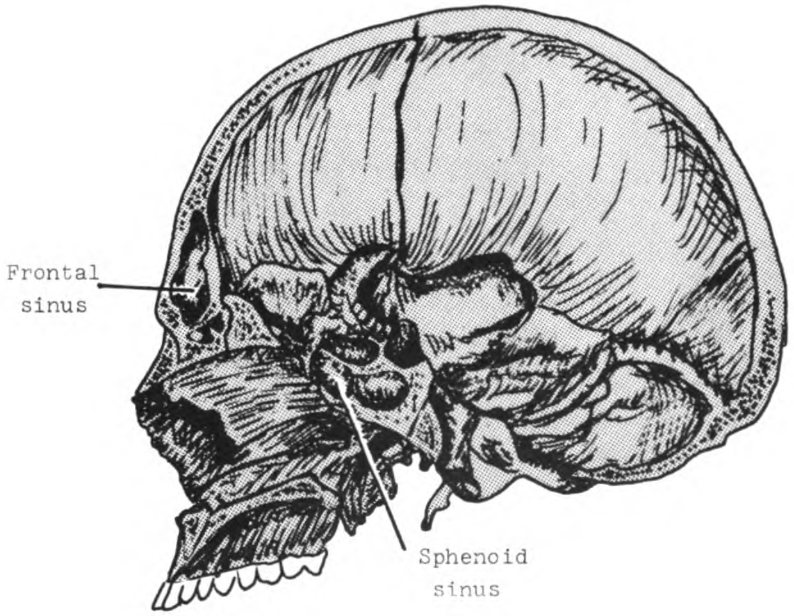
Figure 41. Bone classifications malleolus and foramen are defined.

FISSURE: a narrow slit between bones. See Figure 42A.

SINUS or ANTRUM: terms used to designate a hollow space within a bone. See Figure 42B.



A. Frontal view of the skull.



B. Transverse skull section.

Figure 42. Bone classifications fissure and sinus are defined.

CLASSIFICATION OF JOINTS AND ARTICULATIONS

Bones are connected by dense white bands of connective tissue called ligaments. The place where two or more bones in the skeleton meet is called a joint, or articulation. Joint surfaces which touch each other are covered with cartilage. The dense bluish mass of elastic connective tissue that coats the articular ends of the bones is called hyaline cartilage. White fibral cartilage is a mixture of fibers and cartilage. Fibral cartilage forms the discs and menisci which are often interposed between bones.

Articular capsules completely envelop freely movable joints. The inner surface of these capsules is lined with a synovial membrane. This membrane exudes the synovial fluid which lubricates the joints. Synovial bursae, the closed sacs filled with this fluid, are situated in places at which friction would otherwise develop. Joints are classified into three groups according to their freedom of movement as 1) immovable (synarthroses), 2) slightly movable (amphiarthroses) and 3) freely movable (diarthroses).

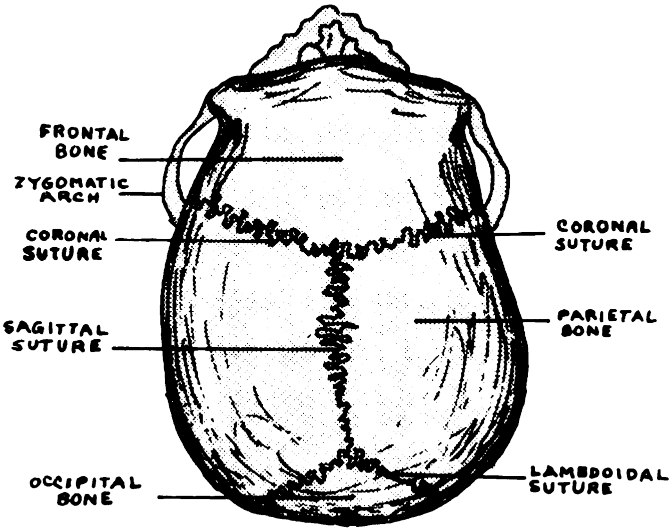
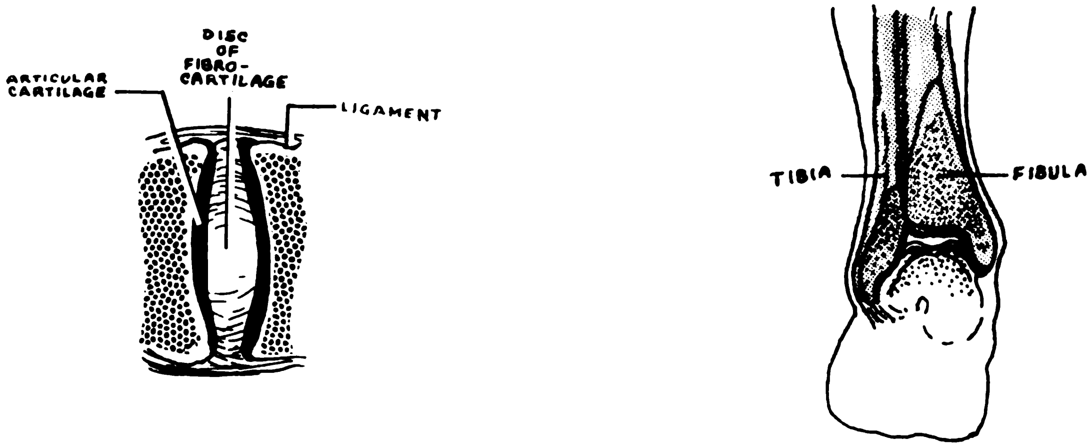


Figure 43. Immovable joint: skull suture (synarthrosis).

SYNARTHROSES OR IMMOVABLE: these include all those joints in which the surfaces of the bones are in almost direct contact, fastened together by intervening connective tissue. The sutures of the skull are representative of this group.

AMPHIARTHROSES OR SLIGHTLY MOVABLE: these include those joints whose contiguous surfaces are connected by fibrocartilaginous discs or by an interosseous ligament. Those connected by fibrocartilaginous discs are called symphyses. An example of this type is the symphysis pubis. A joint connected by an interosseous ligament is called syndesmosis; for example, the tibiofibular syndesmosis.



A. Diagram of a symphysis (symphysis pubis).

B. Tibiofibular syndesmosis.

Figure 44. Typical joints that are slightly movable (amphiarthroses).

DIARTHROSES or FREELY MOVABLE: these comprise the largest number of joints. T have cartilage covering the contiguous bony surfaces. The connecting capsule, posed of ligaments, is lined with a synovial membrane which exudes lubricating Some of the diarthrodial joints are divided by an articular disk. The elbow a knee are representative of the diarthrodial joints.

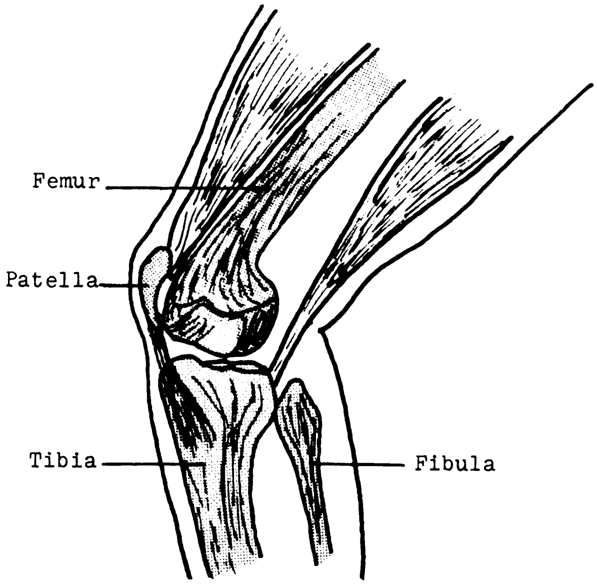
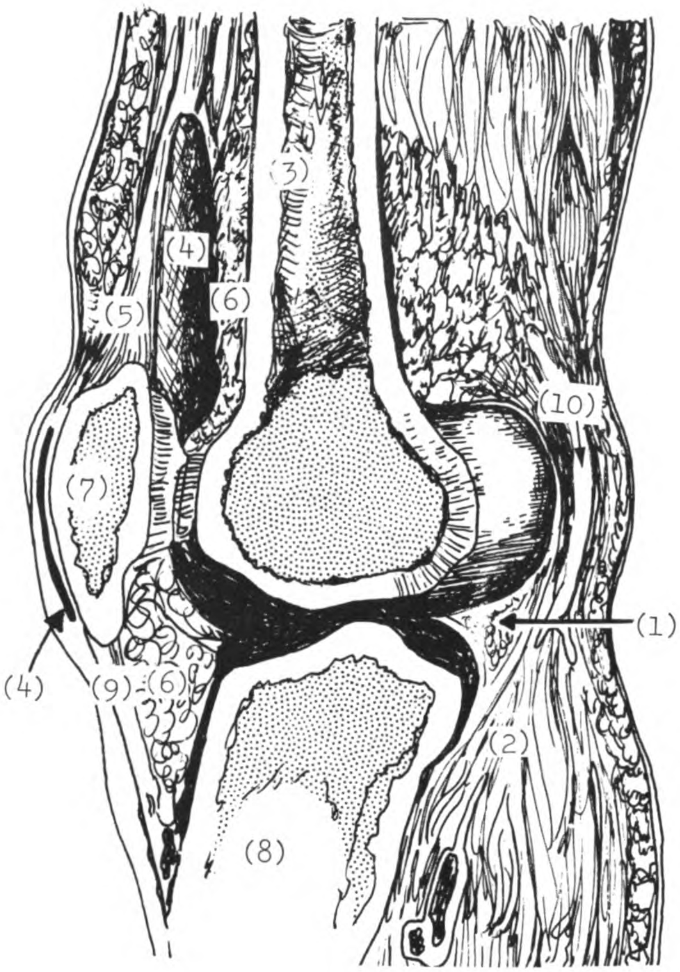


Figure 45. Freely movable joint (diarthroses): the knee.

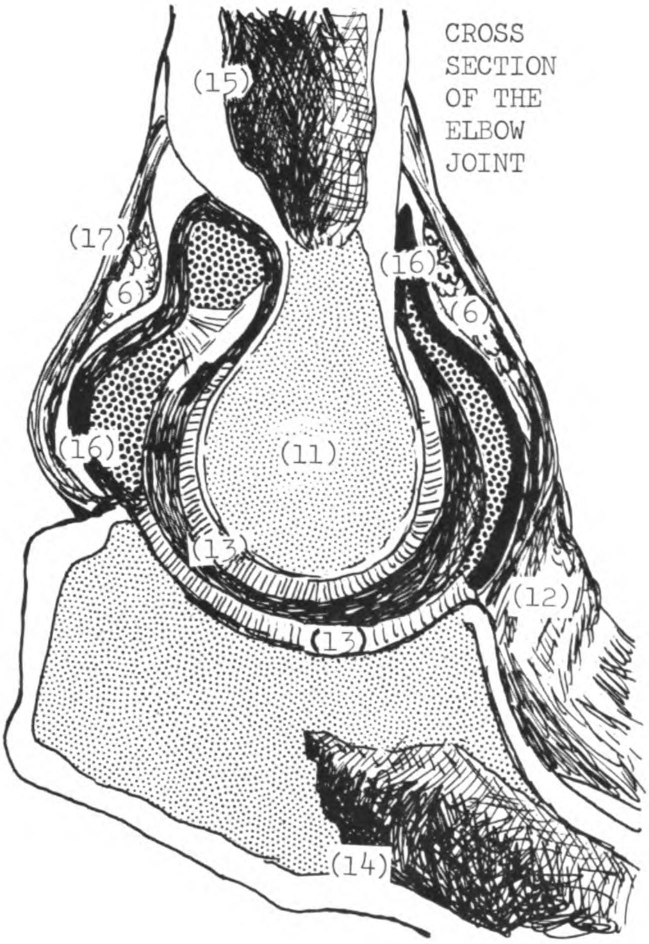
DIARTHRODIAL joints are divided into the following groups:

Division	Movement	Example
Gliding	Gliding	Sterno-clavicular
Ball-and-socket	Angular, rotation, circumduction	Hip
Condyloid	Angular, circumduction	Wrist
Hinge	Angular, (single axis)	Elbow
Pivot	Rotation	Atlas, axis
Saddle	Angular	Carpometacarpal of the th



(1) Lateral Meniscus
(2) Popliteal Ligament
(3) Femur
(4) Bursa
(5) Quadriceps Muscle Tendon
(6) Fat Pad
(7) Patella
(8) Tibia
(9) Patellar Ligament
(10) Popliteal Artery

Figure 46. The knee joint, a diarthrosis of the hinge type, is the largest joint in the body.



(11)	Trochlea of the humerus
(12)	Head of radius
(13)	Articular cartilage
(14)	Ulna
(15)	Humerus
(16)	Synovial membrane
(17)	Capsule binding the bones together

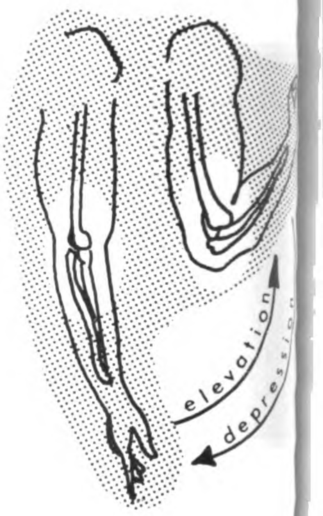
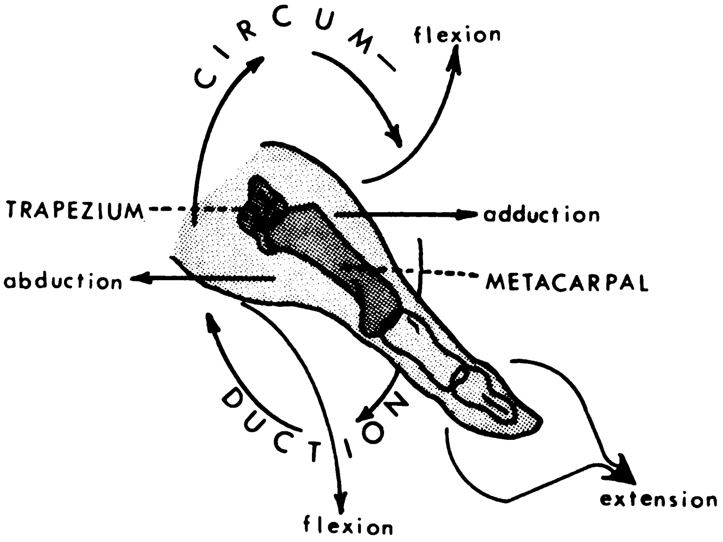
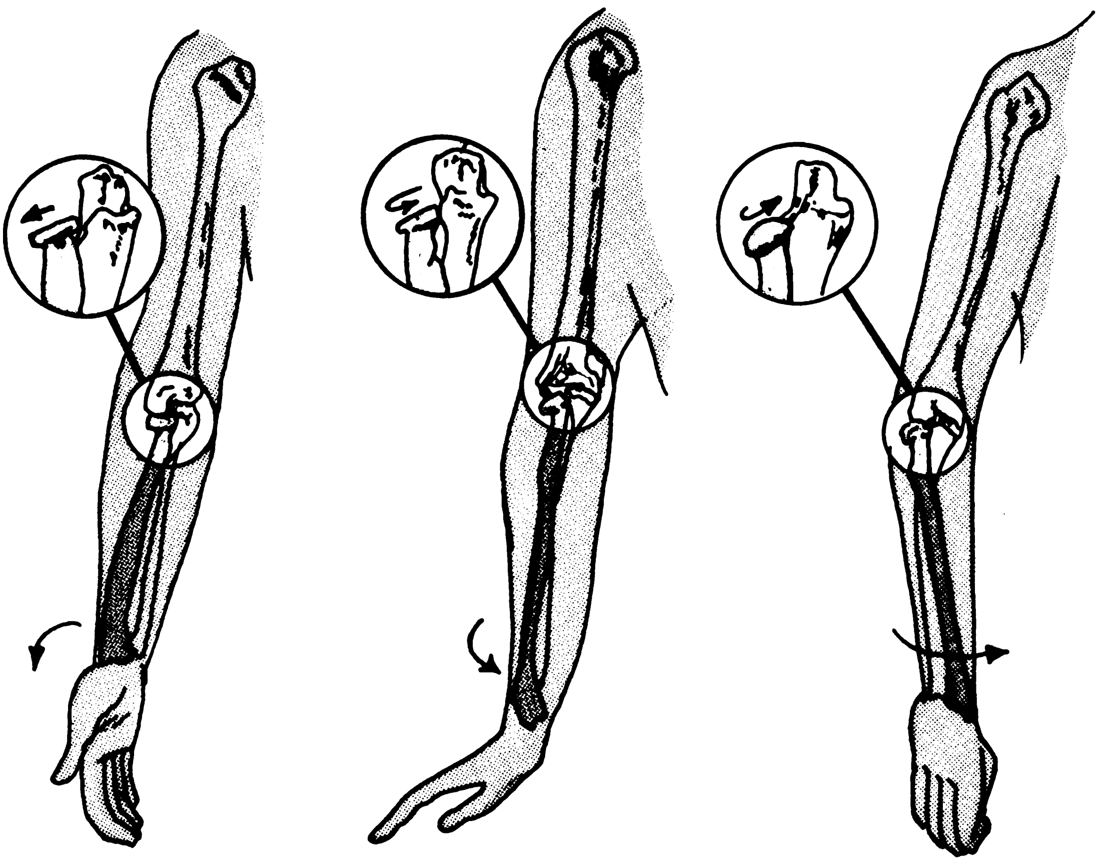


Figure 47. The elbow is a ginglymus or hinge joint.

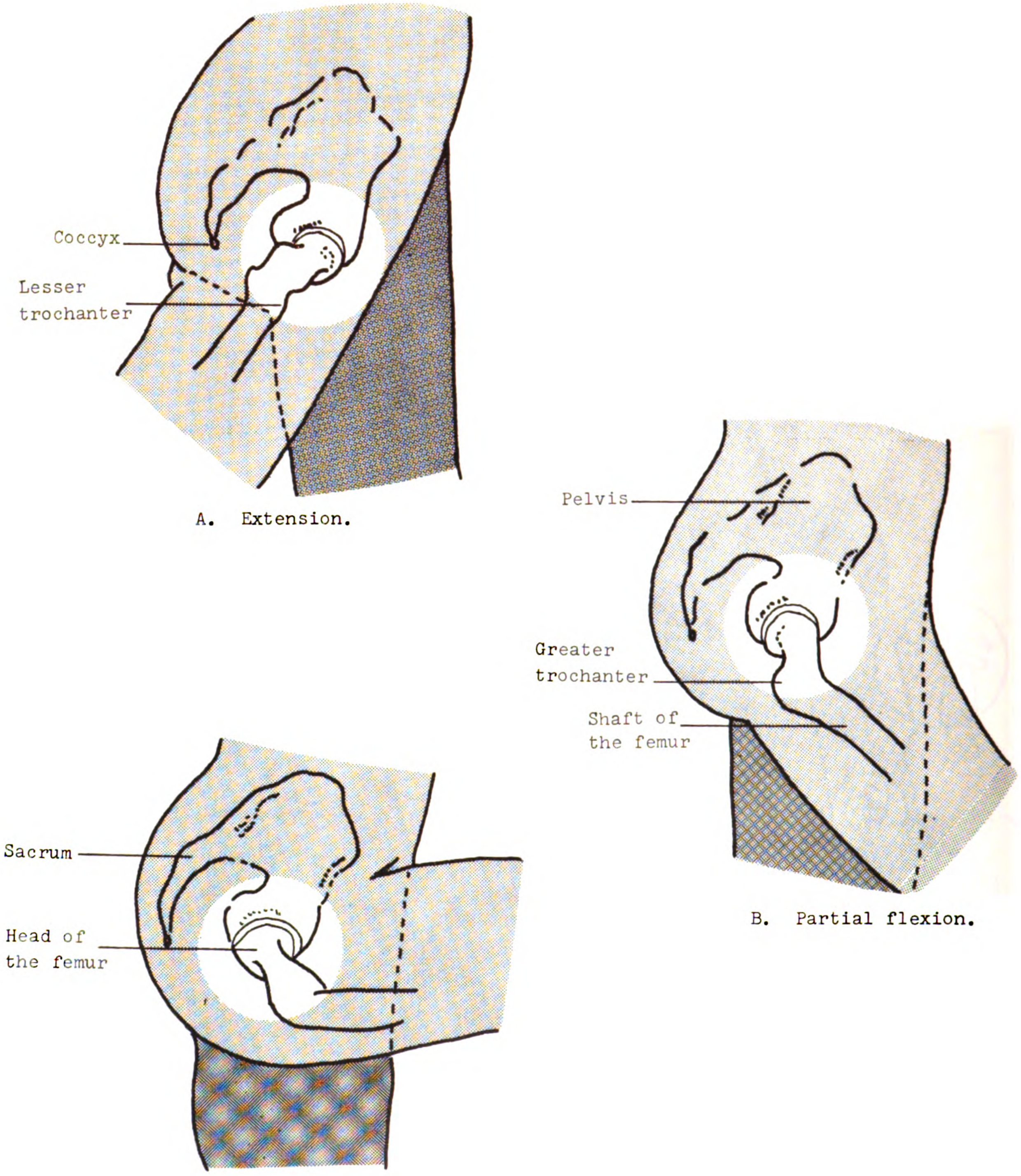


A. Carpo-metacarpal joint of the right thumb: example of the saddle joint articulation.



B. Proximal radioulnar articulation: an example of a pivot joint.

Figure 48. Examples of saddle joint and pivot articulation.



A. Extension.

B. Partial flexion.

C. Further flexion.

Figure 49. The hip joint: an example of ball-and-socket articulation.

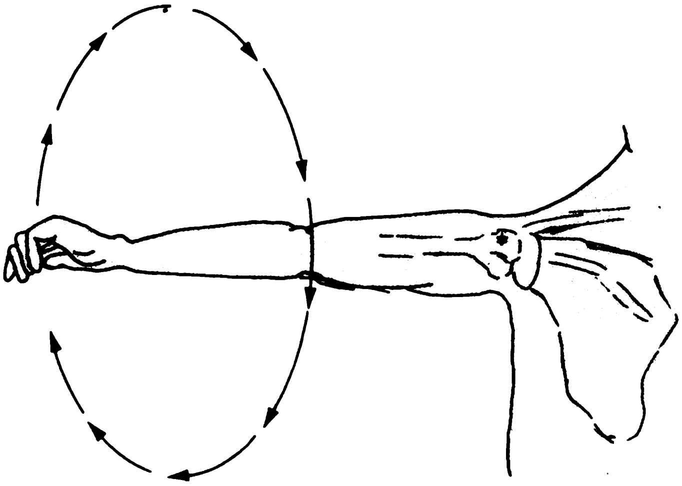


Figure 50A. Circumduction of the shoulder.
*head of the humerus

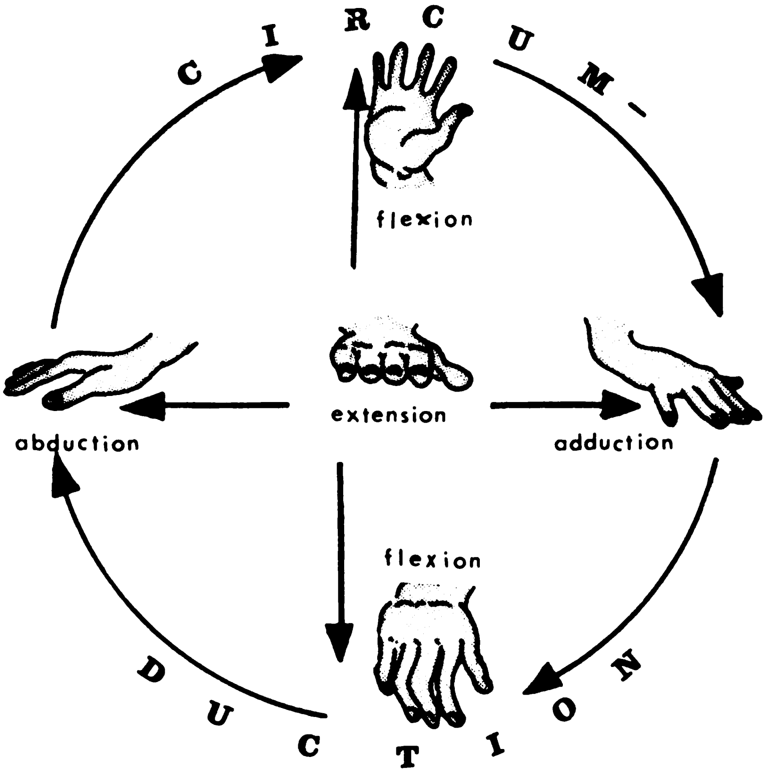


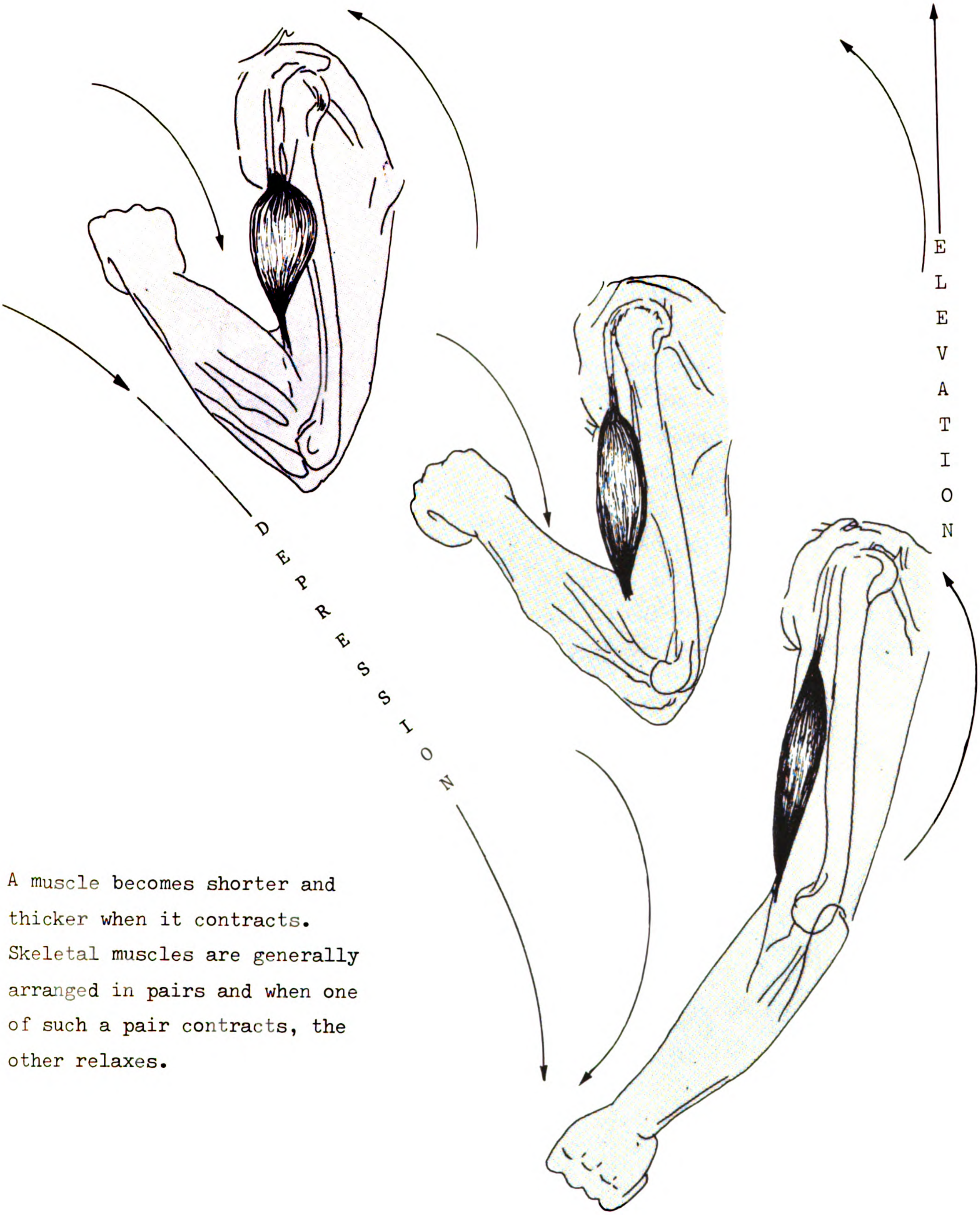
Figure 50B. The wrist joint: an example of a condyloid articulation (has no axial rotation).

CLASSIFICATION OF MUSCLES AND MOVEMENTS

Muscles are attached to bone by tendons (cords of white, fibrous connective tissue). Muscle tissue is made of bundles of fibers, each fiber being about the size of a human hair. A fiber can support one thousand times its own weight. We have about six billion fibers in the more than six hundred muscles of the body.

Muscles are either voluntary or involuntary muscles. They are voluntary if we are able to control their actions, i.e., lift an arm or a leg. They are involuntary if we have no control over their actions. Such muscles found in the internal organs are the stomach, the intestines and the blood vessels.

A third kind of muscle, found in the heart, is called the cardiac muscle. It is also involuntary, but it possesses the capacity for restimulating its own rhythmic activity and is capable of continuous response.

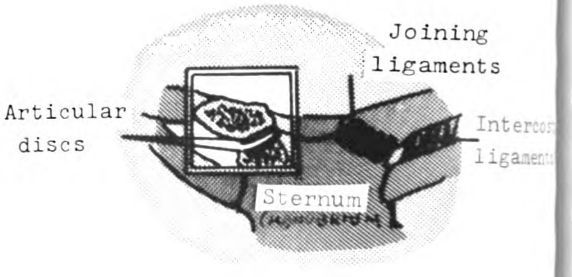


A muscle becomes shorter and thicker when it contracts. Skeletal muscles are generally arranged in pairs and when one of such a pair contracts, the other relaxes.

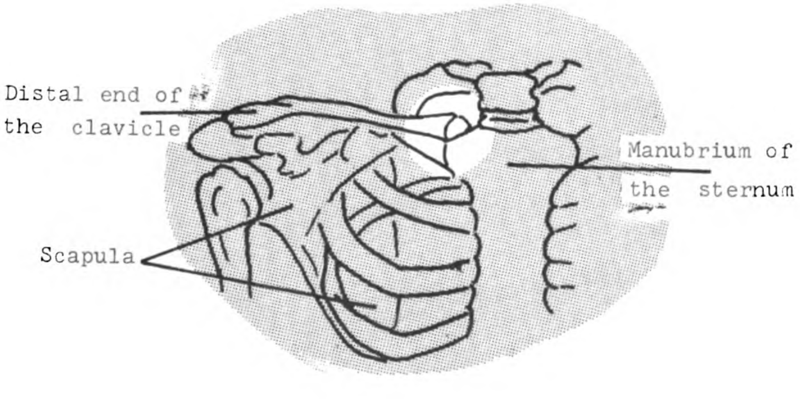
Figure 51. Muscle contraction as exemplified in the biceps brachii.

Some muscles, which are attached to bones by tendons, contract and provide the force which institutes various movements. Those movements may be described as follows:

A. Gliding movement - common to all movable joints, and the simplest kind of motion that can take place. In this movement, one surface glides over another without any angular rotating movement. In some joints, as in most of the articulations of the carpus and tarsus, it is the only motion permitted. The gliding movement may exist between any two contiguous surfaces, of whatever form.



A. Sternoclavicular articulation: transverse section of the joint ins



B. Sternoclavicular joint.

Figure 52. Muscles for gliding movement, sternoclavicular articulation.

(1) Inversion - to turn the sole of the foot medially.

(2) Eversion - to turn the sole of the foot laterally.

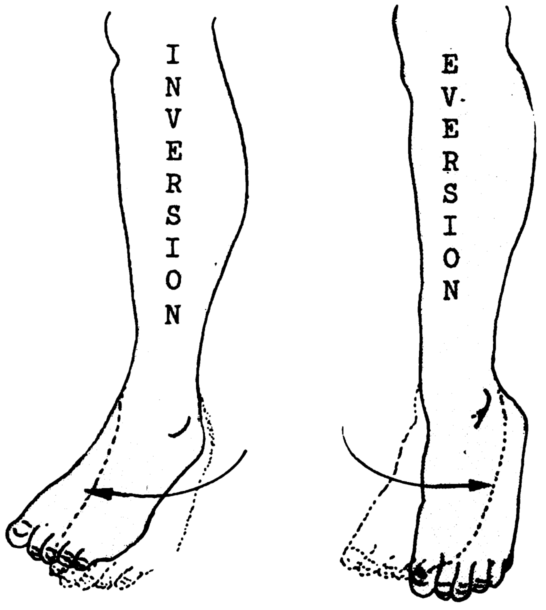


Figure 53A. Inversion and eversion.

Angular movement

(1) Adduction - movement toward the median plane of the body.

(2) Abduction - movement away from the median plane of the body.

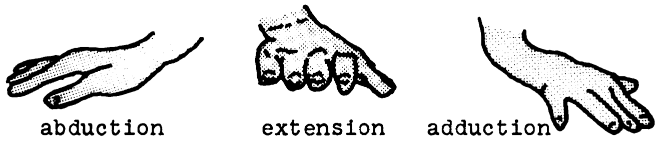


Figure 53B. Abduction and adduction.

(3) Flexion - movement to decrease the angle between the parts.

(4) Extension - movement to increase the angle between the parts.

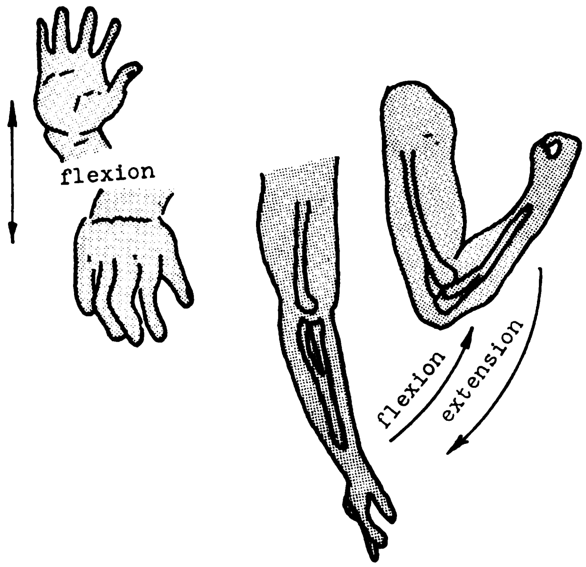


Figure 53C. Flexion and extension.

C. Special movements

(1) Pronation - to turn the palm of the hand (from the normal anatomical position) posteriorly.

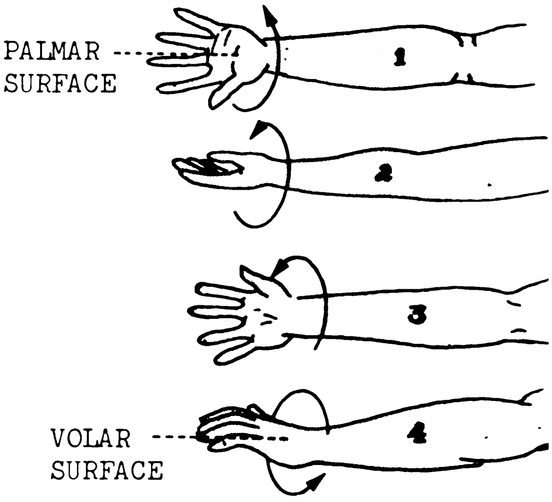


Figure 54A. Pronation.

(2) Supination - to turn the palm of the hand from posterior to anterior (to regain the normal anatomical position).

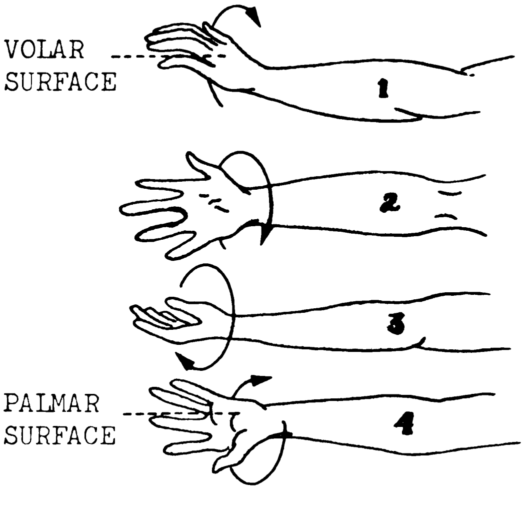


Figure 54B. Supination.

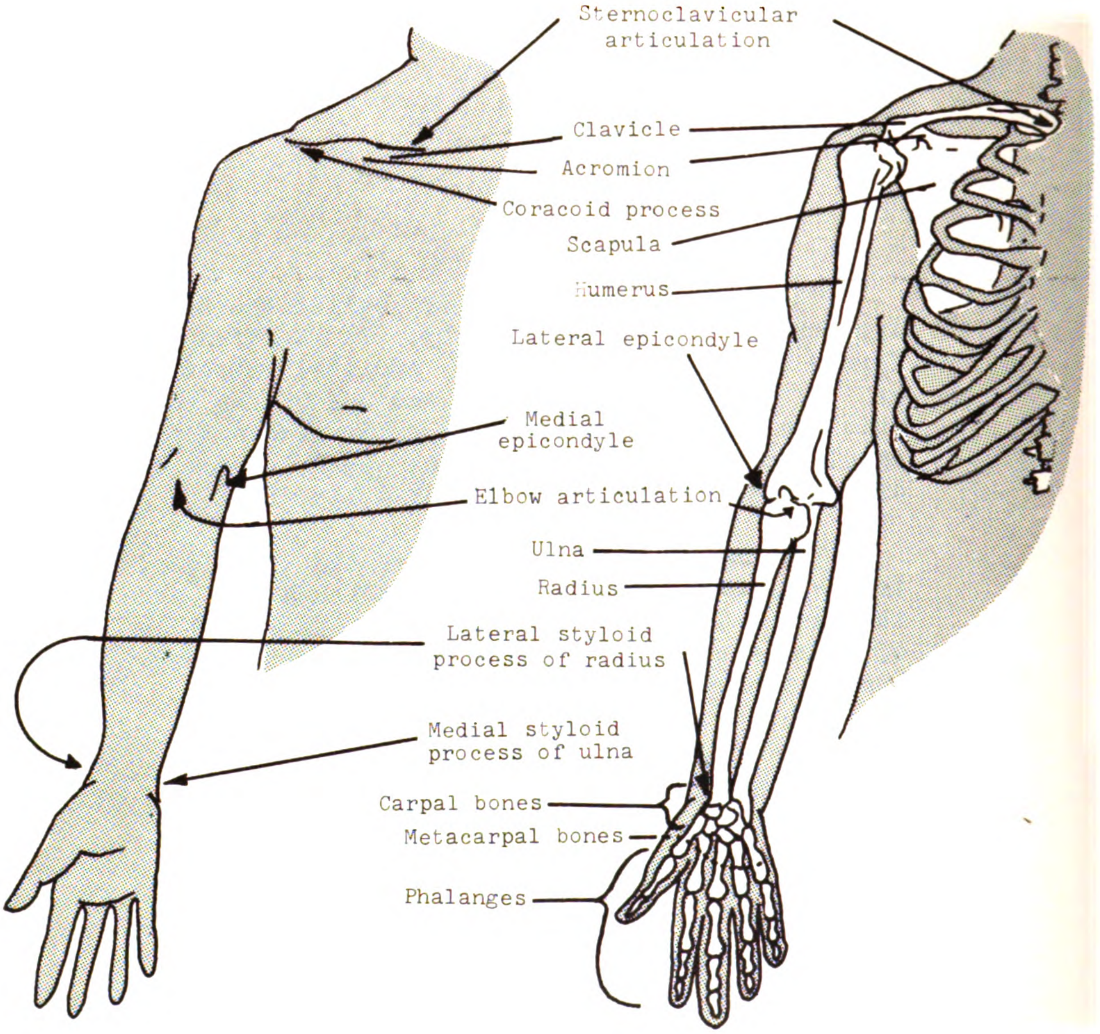
CHAPTER IV

OSTEOLOGY OF THE UPPER EXTREMITIES

The upper extremity is called the upper limb or the arm by the laiety. It is often referred to as the superior or proximal extremity as it lies closer to the head end of the body than the lower extremity or limb. These terms should not be confused with the upper, superior or proximal extremity or end of a long bone.

The upper extremity includes the shoulder, the arm (brachium), forearm (antibrachium) and the hand. On the following pages the osteology of each part of the upper extremity will be discussed in detail.

The appendicular skeleton consists of 126 bones. There are 60 of these 1
bones in the upper extremities and 4 in the shoulder girdle.



A. External aspect.

B. Skeletal aspect.

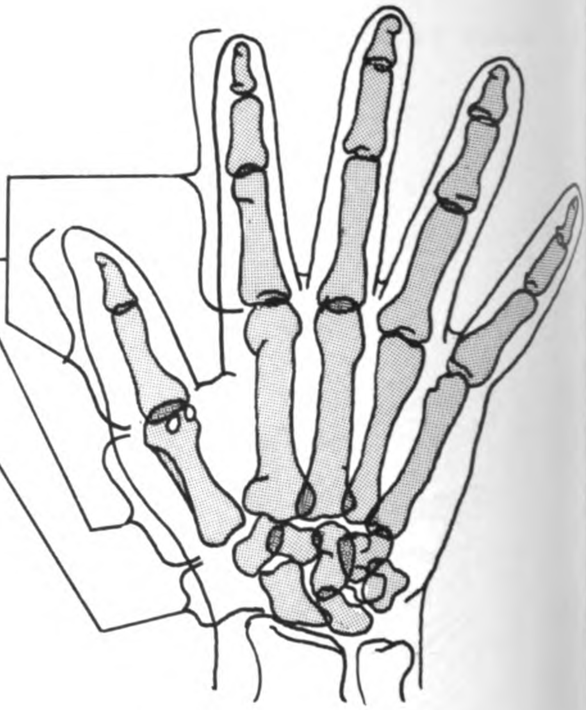
Figure 55. The upper appendicular skeleton.

OSTEOLOGY OF THE UPPER EXTREMITIES

The bones of the upper extremity are divided into four groups:

1. The hand, which is composed of three parts:
    a. digits, or fingers (14 phalanges)
    b. hand proper, or palm (5 metacarpal bones)
    c. carpal region, or wrist (8 carpal bones)
2. The forearm, between the elbow and the wrist, composed of two parts:
    a. radius (lateral portion)
    b. ulna (medial portion)
3. The arm, between the shoulder and the elbow, composed of the humerus.
4. The shoulder girdle, composed of two parts:
    a. scapula ("shoulder blade")
    b. clavicle ("collarbone")

The hand is divided into three parts: the fingers or phalanges or digits, the palm of the hand or metacarpals, and the wrist bones or carpals.



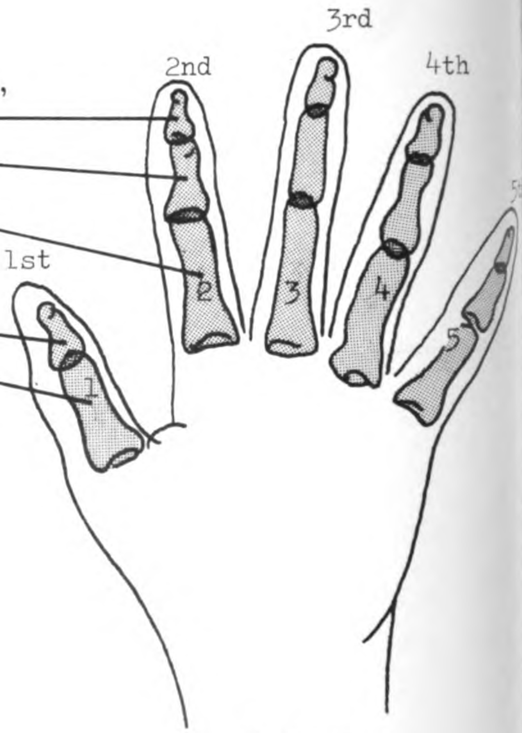
A. Postero-anterior view of the right hand.

The phalanges are the bones of the digits or fingers. Each finger, except the thumb, has three phalanges: a distal,
a middle,
and a proximal.

The thumb has only two phalanges:
a distal,
and a proximal.

The digits are called:

1st digit - thumb
2nd digit - forefinger or index
3rd digit - middle finger
4th digit - ring finger
5th digit - little finger

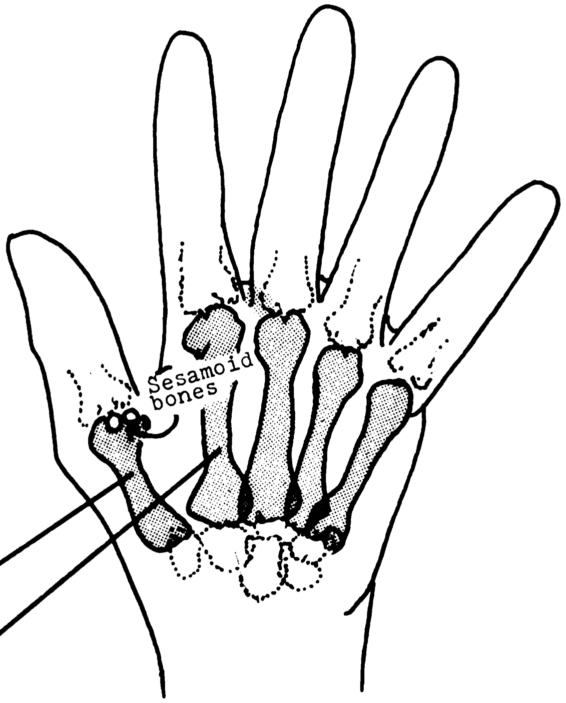


B. Phalanges.

Figure 56. The hand, phalanges.

The bones of the palm or metacarpals are a series of five long bones.
Each bone is divided into three parts:
a distal,
a body,
and a proximal part.

The first metacarpal bone is shorter and broader than the others.
The second metacarpal bone is the longest.
The distal portion of the metacarpal bones articulates (joins) with the phalanges, the proximal portion articulates (joins) with the carpal bones.

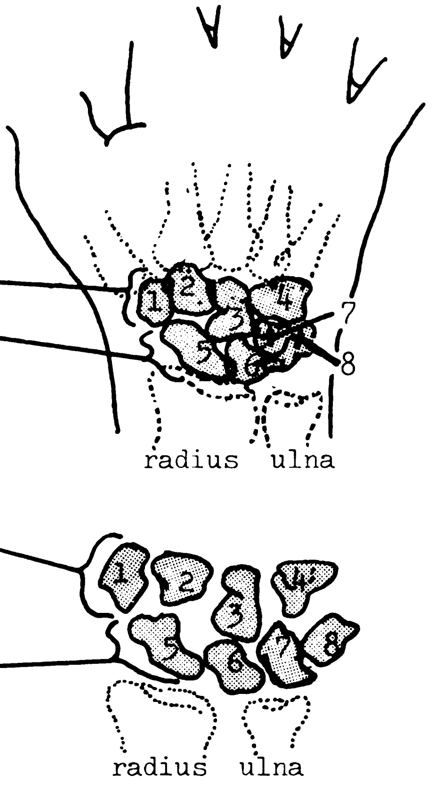


A. Metacarpals.

The bones of the wrist or carpal bones are composed of eight bones, arranged in two rows: a distal,
and a proximal,
with four bones in each row.

The distal row articulates with metacarpus.
The proximal row articulates with the radius.

The bones of the distal row are:
greater multangular or trapezium, (1)
lesser multangular or trapezoid, (2)
capitate or os magnum, (3)
and hamate or unciform. (4)
The bones of the proximal row are:
navicular or scaphoid, (5)
lunate or semilunar, (6)
triquestral or triangular, (7)
and the pisiform. (8)



B. Carpals.

Figure 57. The hand, metacarpals and carpals.

FOREARM

THE RADIUS

The radius lies parallel with the ulna and is on the lateral, or the thum of the forearm. Its proximal end is small, and forms only a small part of the e point, but its distal end is large, and forms the chief part of the wrist joint. has an upper, proximal or superior extremity (end) including a head, neck and ra tuberosity; a body or shaft; and a lower, inferior or distal extremity includi the distal articular surface, the styloid process, and ulnar notch.

The head of the radius is the upper expanded disc-like end that articulates with the capitulum of the humerus.

The neck is the constricted part immediately below the head.

The radial tuberosity is a prominence below the neck on the antero-medial b to it is attached the biceps tendon. The lower articular surface is expanded, a its large articular surface helps to form the wrist joint.

The styloid process is a bony prominence on the outer (lateral) border and tal end of the radius, which can be felt through the skin.

The shaft is the long, somewhat rounded and slightly curved body of the bon between the two extremities.

The ulnar notch is a depression on the inner border of the lower radius jus above its lower end, into which the ulna fits.

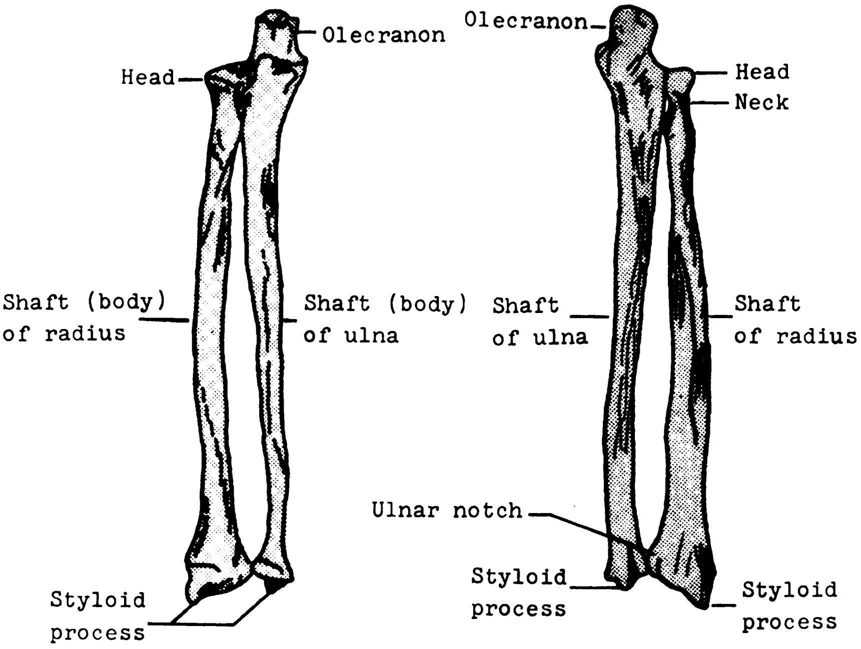
THE ULNA

The ulna occupies the medial or little finger side of the forearm, and lies parallel with the radius. It has an upper, proximal, or superior extremity (end) including the olecranon, coronoid process, and semilunar notch; a shaft or body; a lower, inferior or distal end including a head, and styloid process.

The olecranon is the blunt rounded upper end of the ulna, that can be felt through the skin at the back of the elbow. Its tip fits into the olecranon fossa f the humerus when the lbow is extended.

The coronoid process orms a beak-like projecion from the anterior urface (front) of the lna below the olecranon. t fits into the coronoid ossa of the humerus when he elbow is flexed.

The semilunar (half-oon) notch or trochlear otch is a small half-moon haped concave hollow on the front of the upper lna, formed by the antrior surface of the oleranon, and the upper border of the coronoid process. It accommodates the trochlea of the humerus.



A. Anterior view. B. Posterior view.

Figure 58. The right forearm.

The radial notch is a small hollow or oncavity on the lateral border of the semilunar otch of the ulna and the head of the radius fits nto this at its side.

The shaft of the ulna is somewhat rounded nd becomes smaller as it approaches the wrist.

The head of the ulna is its lower expanded nd, and can be felt through the skin.

The styloid process of the ulna is a small bony prominence extending down from the postero-medial border of the head, and can be palpated felt) through the skin. The radial styloid is much larger, and reaches a lower level than the ulnar styloid.

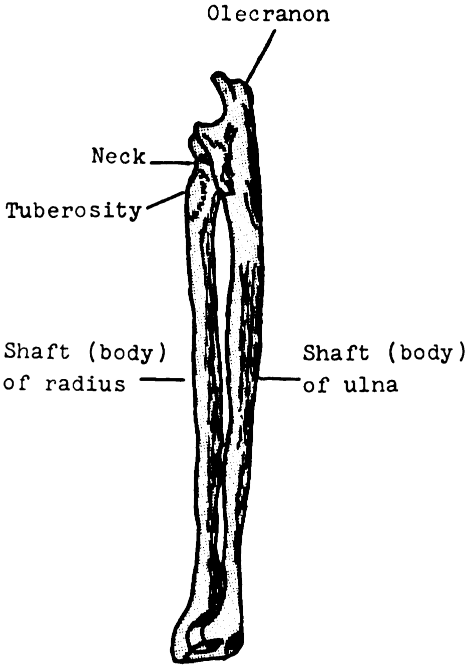
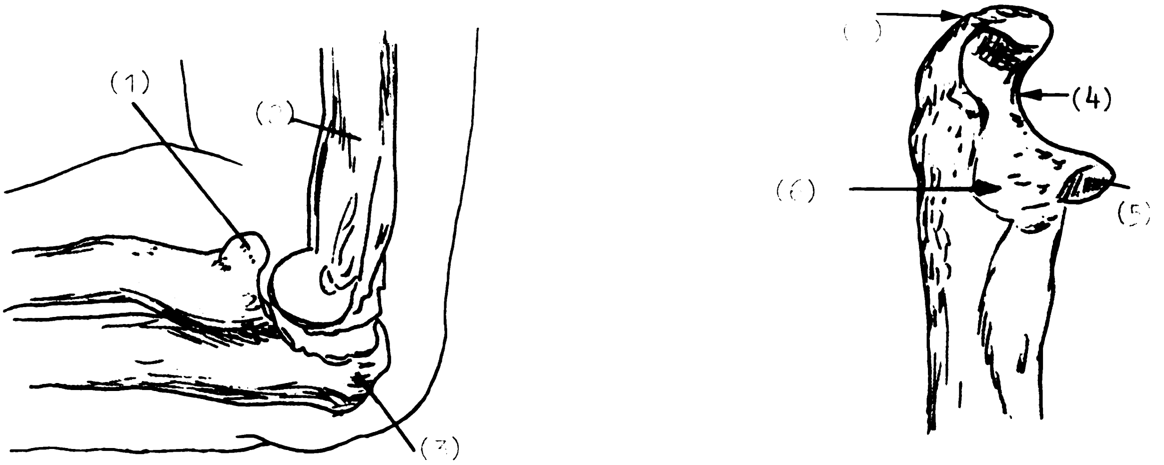


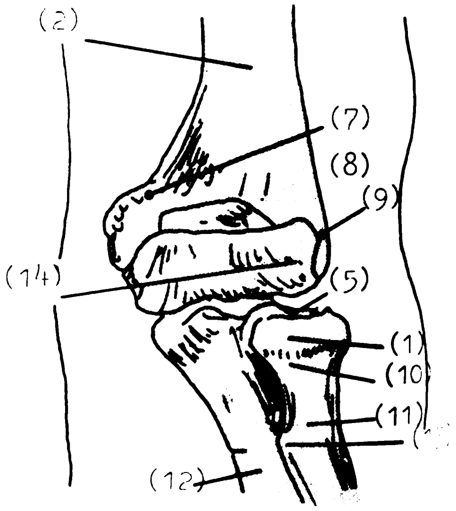
Figure 59. Medial view of the right forearm.



A. Lateral aspect of left elbow.

B. Lateral aspect of the proximal one-third of the left ulna.

(1)	Head of the radius.
(2)	Shaft of the humerus.
(3)	Olecranon process.
(4)	Trochlear notch.
(5)	Coronoid process.
(6)	Radial notch.
(7)	Medial epicondyle.
(8)	Coronoid fossa.
(9)	Lateral epicondyle.
(10)	Neck of the radius.
(11)	Shaft of the radius.
(12)	Shaft of the ulna.
(13)	Radial or bicipital tuberosity.
(14)	Capitulum.



C. Anterior aspect of the left elbow.

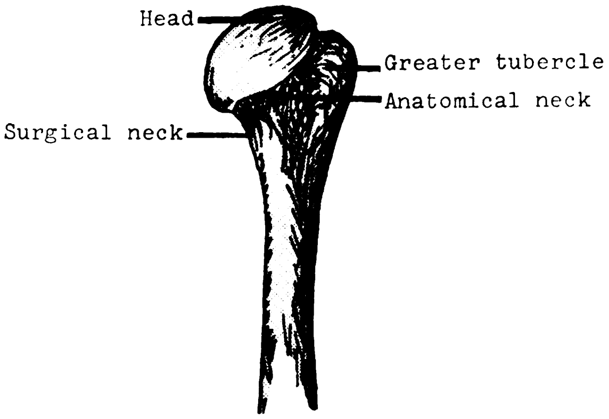
Figure 60. The elbow.

HUMERUS

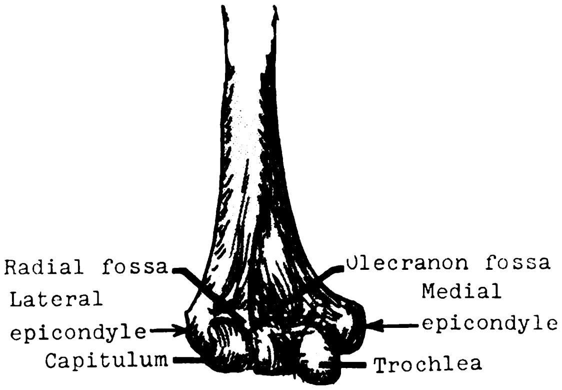
The humerus is the bone of the upper m. It is the longest and largest bone the upper extremity and is composed of shaft and two extremities.

The upper extremity exhibits the head, ich is separated from the shaft by a allow constriction, the anatomical neck. terior to the head, and separated from by the anatomical neck, are two prom- ences separated from each other by a eep groove, the bicipital groove, The arger of these two prominences, the greater uberosity, is lateral to the head. The esser tuberosity is medial and directed orward. Just below the tuberosities and he anatomical neck, is the surgical neck, o called because it is frequently the site f fracture.

The proximal portion of the shaft is lmost cylindrical, and the distal portion s flattened. At about the middle of the ateral aspect of the shaft is a rough, riangular elevation, the deltoid tuberosity.



A. Anterior view of proximal extremity.



B. Dorsal view of distal extremity.

Figure 61. The humerus.

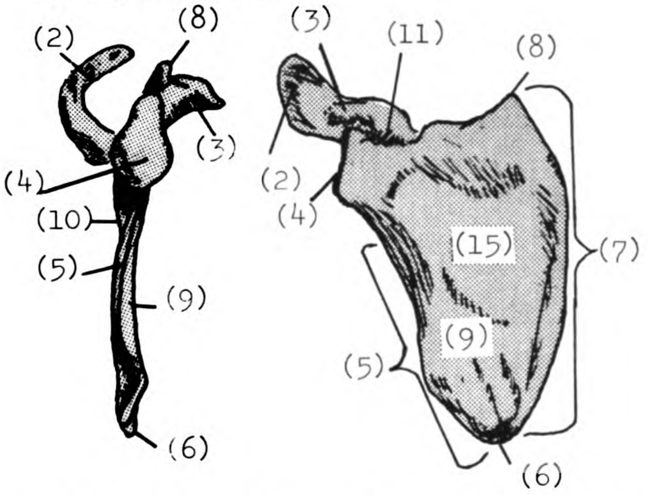
The lower extremity of the humerus is flattened and shows two surfaces for ar- iculation with the forearm. The lateral articular surface is the capitulum and the edial is the pulley-shaped trochlea. Just above the capitulum is a slight depres- ion, the radial fossa, which receives the circumference of the head of the radius uring extreme flexion of the forearm. Above the trochlea is the coronoid fossa, hich receives the coronoid process of the ulna during flexion of the forearm. Pos- eriorly above the trochea is a large, deep triangular depression, the olecranon ossa, into which the olecranon process of the ulna is received in extension of the orearm. The two projections extending from the sides of the distal extremity are he lateral and medial epicondyles. These can be easily palpated (felt).

SHOULDER GIRDLE (SCAPULA)

The shoulder girdle attaches the upper extremity to the trunk. The scapula has no direct or indirect connection with its counterpart of the opposite side. is only indirectly attached to the trunk by means of the clavicle, which closes girdle in front (ventrally). The girdle remains open in back (dorsally) and is freely movable.

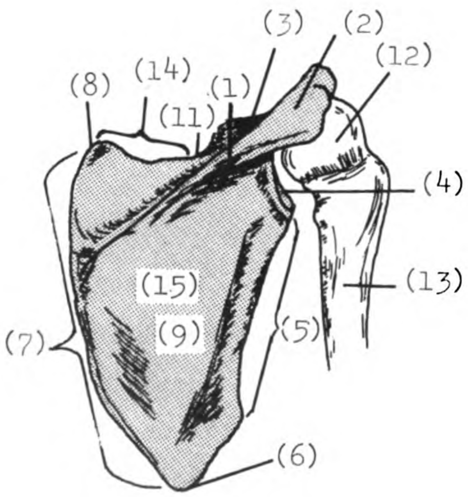
The scapula or shoulder blade is a large, flat, triangular-shaped bone wit several marked processes. It is situat on the dorsal aspect of the thorax, to which it is attached by muscles only. lies between the levels of the second a seventh ribs, with its vertebral border about 2 inches lateral to the vertebral column. It has two surfaces, three borders, and three angles, which can be recognized. See Figure 63, page 85.

The anterior surface of the scapula directed toward the ribs, and is comparatively smooth. It is marked by a concav and somewhat shallow depression termed subscapular fossa. The posterior border



A. Lateral view of the right scapula.

B. Anterior view of the right scapula.



C. Posterior view of the right scapula.

Figure 62. The scapula.

(1) Spine of the scapula
(2) Acromion process
(3) Coracoid process
(4) Glenoid cavity
(5) Axillary border
(6) Inferior angle
(7) Vertebral border
(8) Superior angle
(9) Anterior surface
(10) Posterior surface
(11) Scapular notch
(12) Head of the humerus
(13) Humerus
(14) Superior border
(15) Body of scapula

ightly convex and is divided into two unequal areas by a narrow ridge or crest of ne called the spine. The spine of the scapula terminates laterally in a large iangular projection, the acromion process (2), which forms the tip of the shoulder d can be felt through the skin. The portion above the spine is called the supra- inous fossa and that below it the intraspinous fossa. See Figures 62A, B and C.

The three borders are designated as the vertebral (7), the axillary (5) and the perior (8). The vertebral border is the longest and presents a slight angle at e commencement of the spine. The upper or superior border (14) is the shortest d is thin and sharp. At its lateral end is a depression, the scapular notch (11), d a thick beaklike projection, the coracoid process (3). The coracoid process rls forward beneath the clavicle, and can be palpated (felt) in a depression on e thorax (the infraclavicular fossa). Not infrequently, in thin subjects it may rm a rather prominent projection. The axillary border (5) is the thickest and ies close to the armpit or axilla. See Figure 62C, page 84.

ere are five main parts of the scapula see Figure 62C, page 84):

. SPINE OF SCAPULA (1) - The bony ridge located on the posterior aspect of the scapula. It crosses the scapula transversely.

. ACROMION PROCESS (2) - Continuous with the spine of the scapula, it articulates with the lateral end of the clavicle.

. CORACOID PROCESS (3) - The bony, hook-like projection on the superior portion of the scapula.

. GLENOID CAVITY (4) - A bony depression on the superior-lateral aspect of the scapula. The head of the humerus articulates with the scapula at this point.

. BODY OF THE SCAPULA (15) - The broad, expanded portion of the scapula.

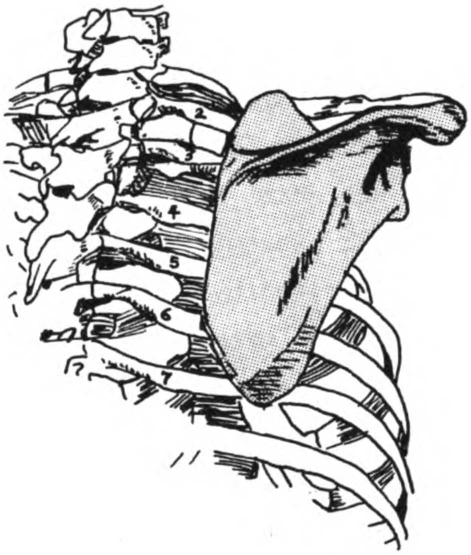


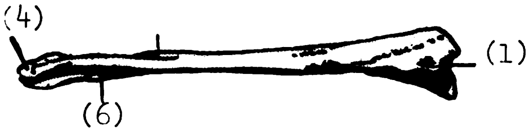
Figure 63.
Posterior view of upper ribs showing location of right scapula.

The three angles are designated medial, inferior and lateral. The medial a is formed by the junction of the superior and vertebral borders. The inferior angle is formed by the union of the vertebral and axillary borders. The lateral angle, formed by the junction of the superior and axillary borders, is the thick part of the bone and is sometimes called the head of the scapula. The head pres a smooth, slightly depressed articular surface, the glenoid fossa or cavity (4), which accommodates the head of the humerus. The glenoid lip is a fibro-cartilag ous rim attached around the margin of the glenoid cavity. The head is separated from the main portion (body) (15) of the bone by a thickened, slightly constric part called the neck. See Figures 62B and 62C, page 84.

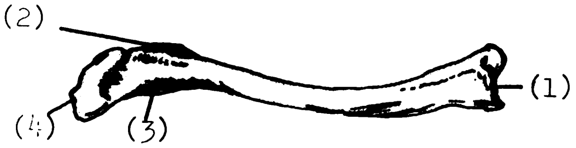
SHOULDER GIRDLE (CLAVICLE)

The clavicle lies nearly horizontal in front of the upper portion of the th at the root of the neck. It articulates laterally with the scapula and medially the sternum. (The degree of curvature varies considerably among individuals and sexes.) The acromio-clavicular joint is between the clavicle and the acromion process of the scapula. The sterno-clavicular joint is between the sternum and the clavicle. See Figure 64, page 87.

The clavicle or collar bone is a long, slender, S-shaped bone with a middle portion, the shaft or body, and two extremities. The sternal extremity is round The acromial extremity is flat. The shaft has two surfaces, a superior and an inferior, separated by anterior and posterior borders. The medial two-thirds of the anterior border presents a convexity and the lateral one-third presents a conca The superior surface is comparatively smooth and subcutaneous and can be easily palpated. Near its sternal end, the inferior surface is marked by a broad, roughened area called the costal tuberosity. Laterally, near the posterior border, is a well-marked roughened eminence, the conoid tubercle.



A. Anterior view of right clavicle.



B. Top view of right clavicle.

(1) Sternal articular facet.

(2) Conoid tubercle.

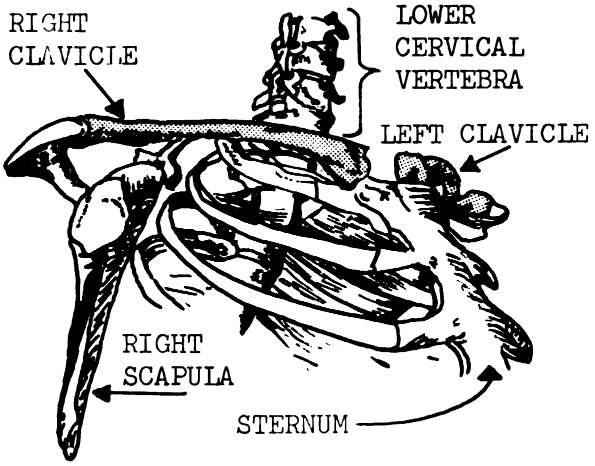
(3) Occasional tubercle.

(4) Acromial articular facet.

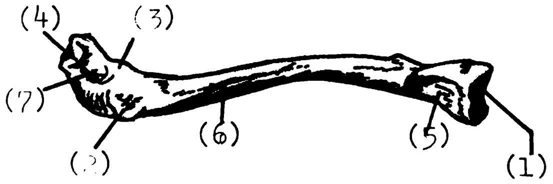
(5) Impression for costoclavicular ligament.

(6) Arterial foramen.

(7) Trapezoid line.



C. Oblique view.



D. View of right clavicle from below.

Figure 64. The clavicle.

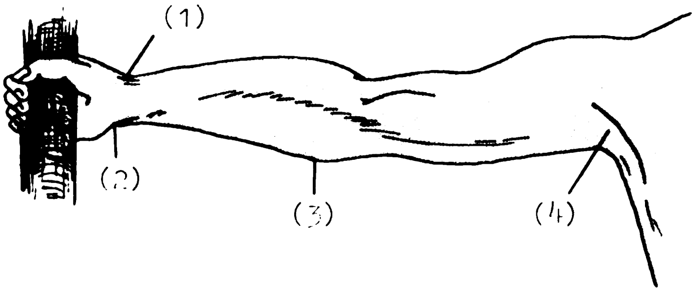
CHAPTER V

SURFACE ANATOMY OF THE UPPER EXTREMITIES

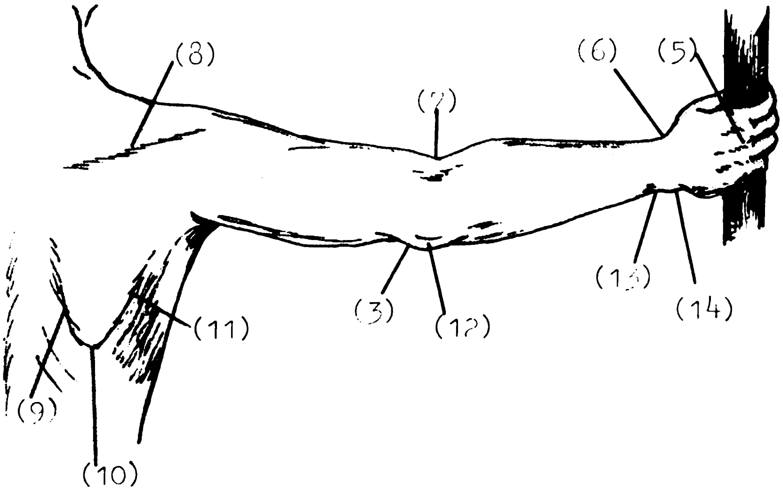
LANDMARKS AND PALPATION POINTS OF THE UPPER EXTREMITY

The important landmarks and palpation points of the upper extremity are shown in the illustrations below. Most of these points of interest can either be seen or palpated (felt) through the skin. They are used in radiography for centering, and should be given special attention. They also serve as landmarks in centering for various structures and organs within the body.

(1) Lateral styloid process.
(2) Medial styloid process.
(3) Medial epicondyle.
(4) Axilla.
(5) Head of the third metacarpal.
(6) Radial styloid.
(7) Lateral epicondyle.
(8) Spine of scapula.
(9) Vertebral border.
(10) Inferior angle of the scapula.
(11) Axillary border.
(12) Olecranon process.
(13) Head of the ulna.
(14) Ulnar styloid.



A. Anterior view.



B. Posterior view.

Figure 65. Landmarks and palpation points of the upper extremity.

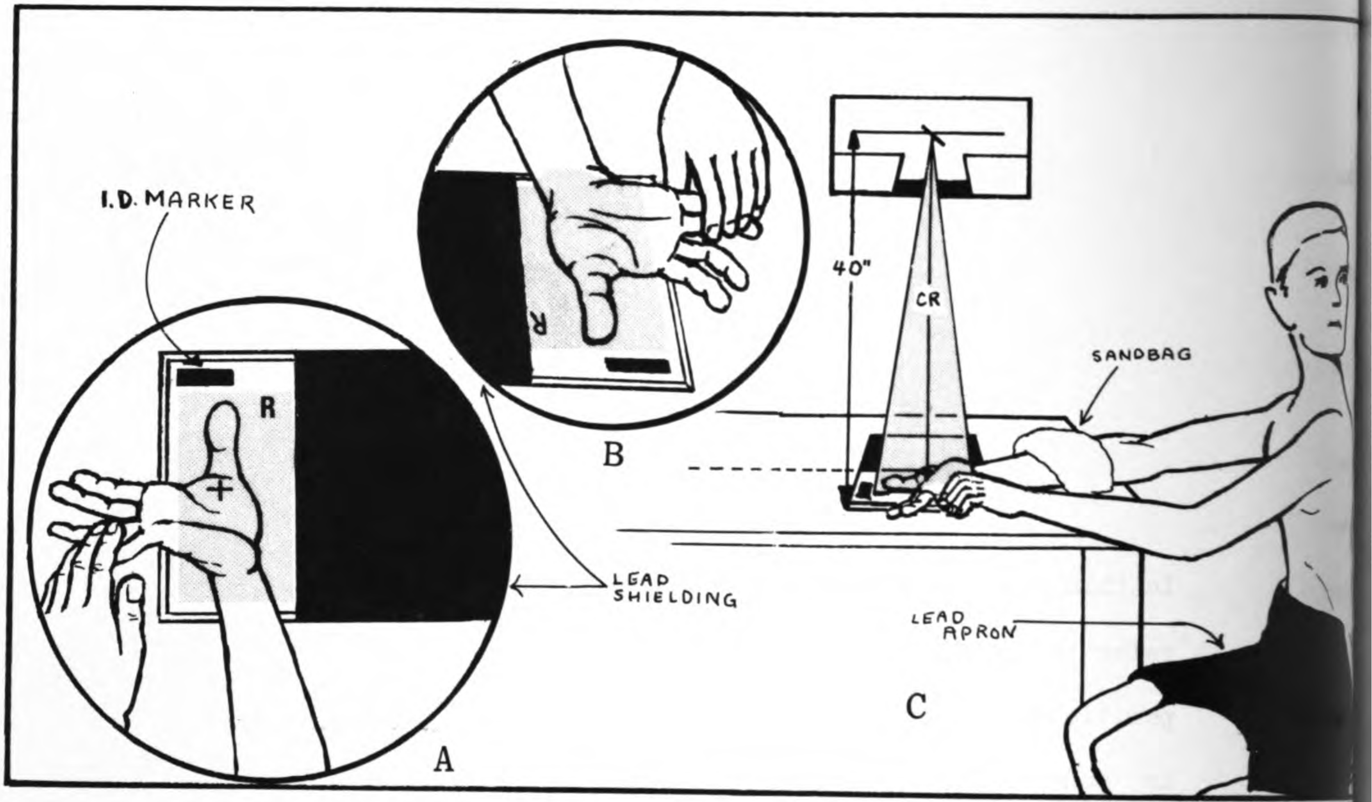
CHAPTER VI

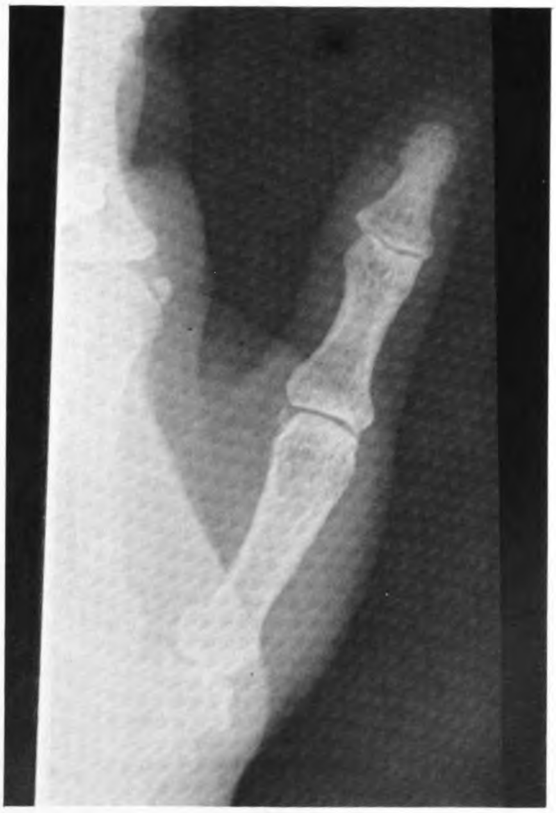
THE RADIOGRAPHIC EXAMINATION

UPPER EXTREMITIES

In this manual, all the positioning illustrations refer to a patient of average size. The various positions illustrated are those generally employed in modern radiography. A routine radiographic examination means a posterior-anterior (PA) or an anterior-posterior (AP) and a lateral view, but each individual doctor establishes his own routine.

Figure 66. Thumb: Anterior-Posterior





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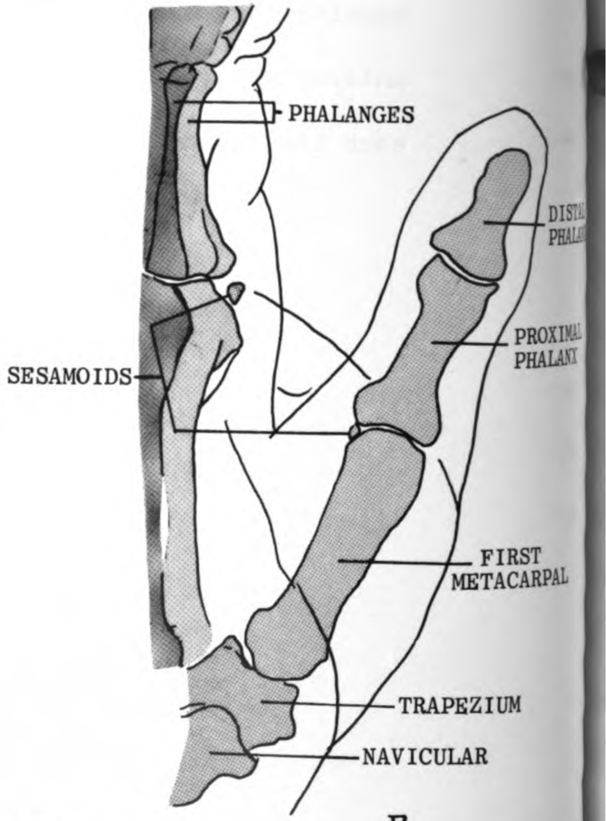


E

SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM S
AP	2-4	100	1/10	50-55	10	40"	YES	NO	NO	0°	8" x
THUMB	2-4	100	1	55-60	100	40"	NO	YES	NO	0°	8" x

THUMB: ANTERIOR-POSTERIOR

uctures Demonstrated:	AP projection of phalanges, metacarpals and associated soft tissues (Fig. 66D and E).
m Size:	8" x 10", lengthwise, two-thirds covered with lead blocker for three views on one film.
m Identification:	ID marker above thumb; right or left marker next to ID marker (Fig. 66B).
ient Preparation:	Wristwatch, bracelets and rings removed.
asuring Reference:	First IP joint (Fig. 66A).
tient Positioning:	Patient seated close to X-ray table. Hand turned in extreme internal rotation. Posterior aspect of thumb in contact with film-holder (Fig. 66A and B).
rt-Film Reference:	Head of first metacarpal to center of unexposed one-third of the film-holder (Fig. 66A and B).
ntral Ray:	Perpendicular to film-holder, through head of first metacarpal to center of unexposed one-third of the film-holder (Fig. 66C).
stance:	40 inches FFD (Fig. 66C).
mobilization:	Sandbag on forearm. Steady fingers of affected hand with unaffected hand (Fig. 66C).
otective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
nstructions to Patient:	"Please do not move."
echnique Changes:	Dry or wet cast: see Glossary.
xplanations:	AP: Anterior-posterior ID: Identification marker IP: Interphalangeal joint CR: Central ray FFD: Focal-film distance

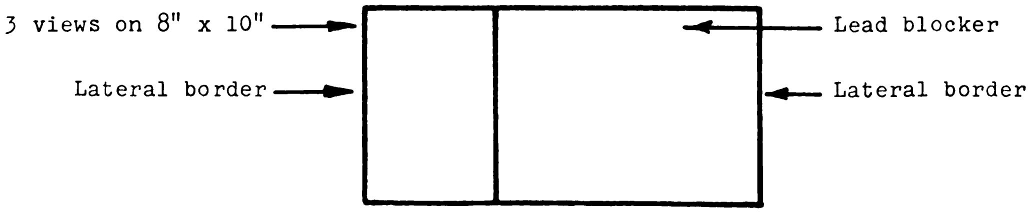
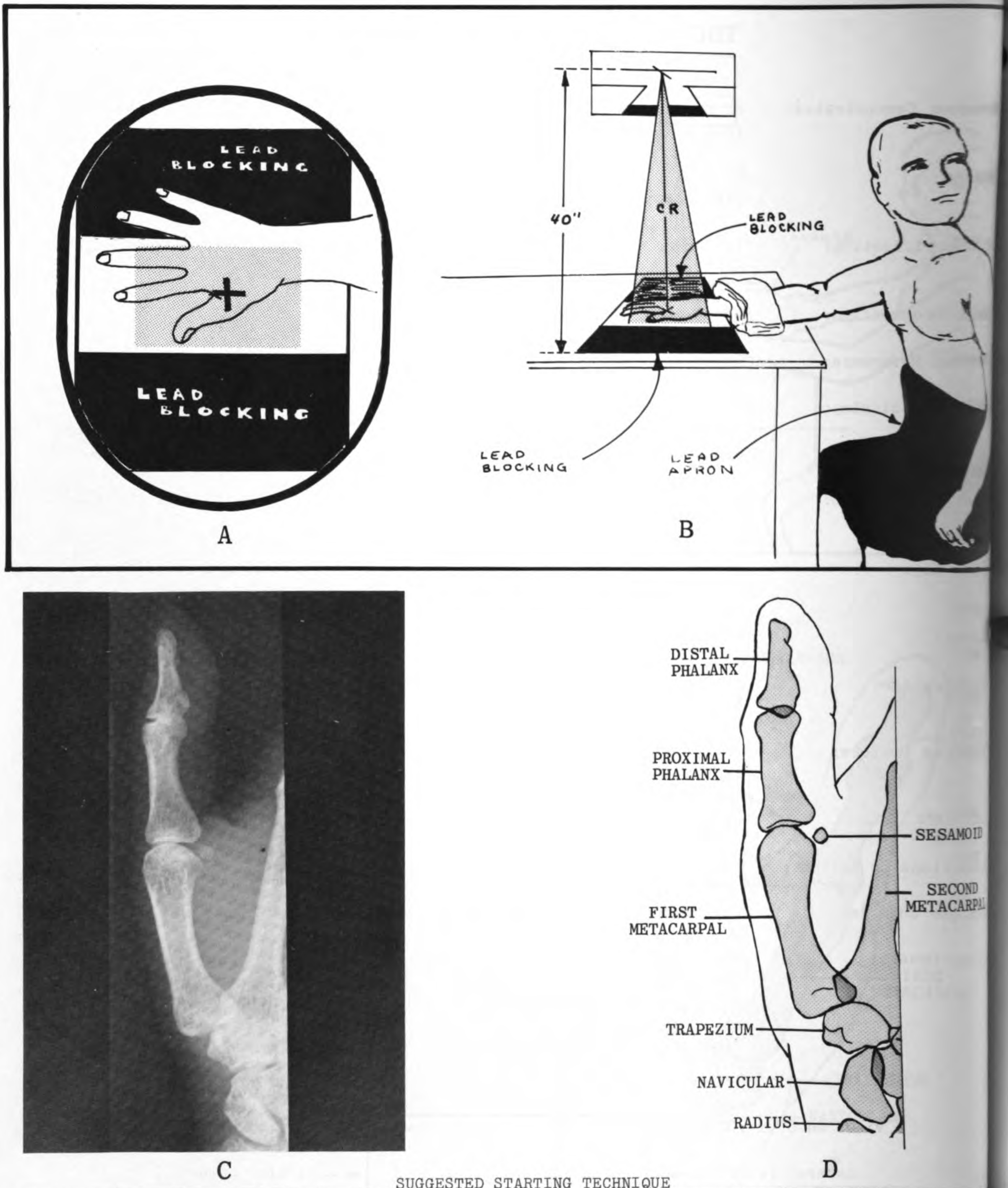


Figure 67. Thumb: Oblique



SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM S
OBLIQUE	2-4	100	1/10	50-55	10	40"	YES	NO	NO	0°	8" x
THUMB	2-4	100	1	55-60	100	40"	NO	YES	NO	0°	8" x

THUMB: OBLIQUE

ctures Demonstrated:	Oblique projection of phalanges, metacarpal and associated soft tissues (Fig. 67C and D).
Size:	8" x 10", crosswise, middle third for oblique view, both lateral thirds covered with a lead blocker.
Identification:	ID marker above thumb; right or left marker next to ID marker (Fig. 67A).
ient Preparation:	Wristwatch, bracelets and rings removed.
suring reference:	First IP joint (Fig. 67A).
ent Positioning:	Palm of hand placed flat on the table with thumb parallel to the film-holder (Fig. 67A).
t-Film Reference:	Head of first metacarpal to center of unexposed middle third of film-holder (Fig. 67A).
tral Ray:	Perpendicular to film-holder, through head of first metacarpal to center of film-holder (Fig. 67B).
stance:	40 inches FFD (Fig. 67B).
nobilization:	Sandbag on forearm (Fig. 67B).
tective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
structions to Patient:	"Please do not move."
chnique Changes:	Dry or wet cast: see Glossary

planations:

IP: Interphalangeal Joint
CR: Central ray
FFD: Focal-film distance
Oblique: Angled half way (usually) between AP (or PA) and lateral.

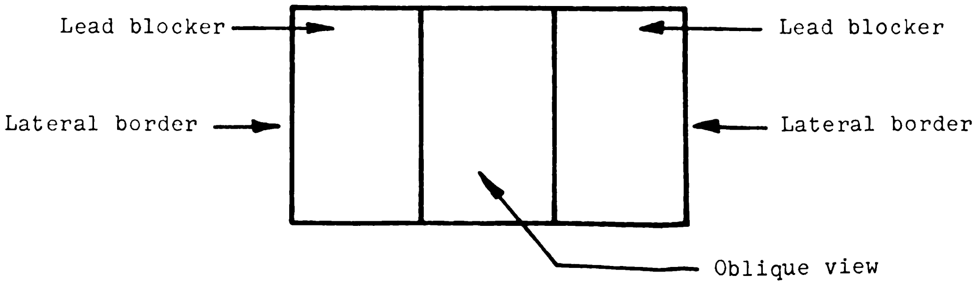
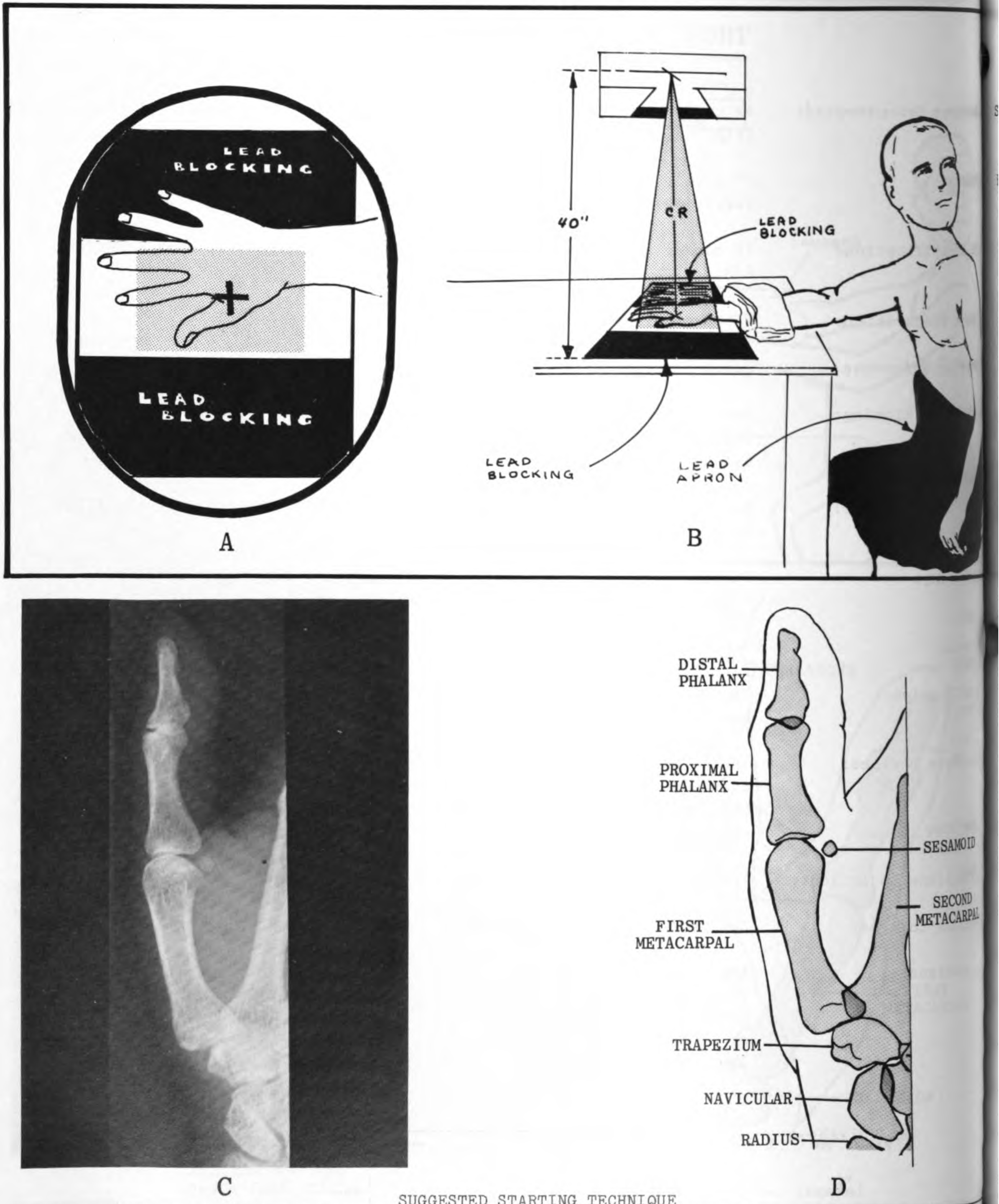


Figure 67. Thumb: Oblique



SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM S
OBLIQUE	2-4	100	1/10	50-55	10	40"	YES	NO	NO	0°	8" x
THUMB	2-4	100	1	55-60	100	40"	NO	YES	NO	0°	8" x

THUMB: OBLIQUE

uctures Demonstrated: Oblique projection of phalanges, metacarpal and associated soft tissues (Fig. 67C and D).

m Size: 8" x 10", crosswise, middle third for oblique view, both lateral thirds covered with a lead blocker.

m Identification: ID marker above thumb; right or left marker next to ID marker (Fig. 67A).

ient Preparation: Wristwatch, bracelets and rings removed.

suring reference: First IP joint (Fig. 67A).

ient Positioning: Palm of hand placed flat on the table with thumb parallel to the film-holder (Fig. 67A).

rt-Film Reference: Head of first metacarpal to center of unexposed middle third of film-holder (Fig. 67A).

ntral Ray: Perpendicular to film-holder, through head of first metacarpal to center of film-holder (Fig. 67B).

stance: 40 inches FFD (Fig. 67B).

mobilization: Sandbag on forearm (Fig. 67B).

otective Devices: Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.

structions to Patient: "Please do not move."

chnique Changes: Dry or wet cast: see Glossary

planations:

IP: Interphalangeal Joint
CR: Central ray
FFD: Focal-film distance
Oblique: Angled half way (usually) between AP (or PA) and lateral.

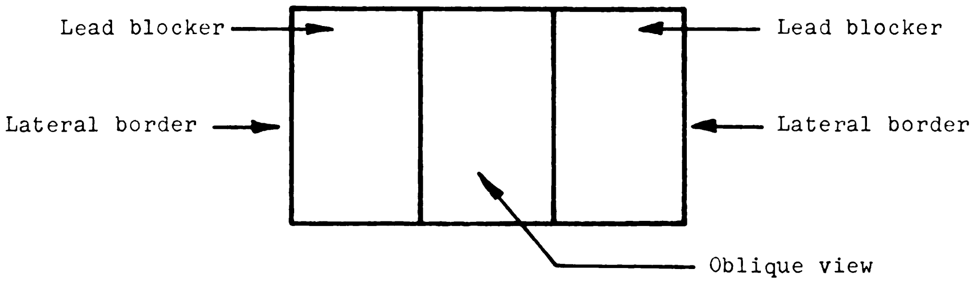
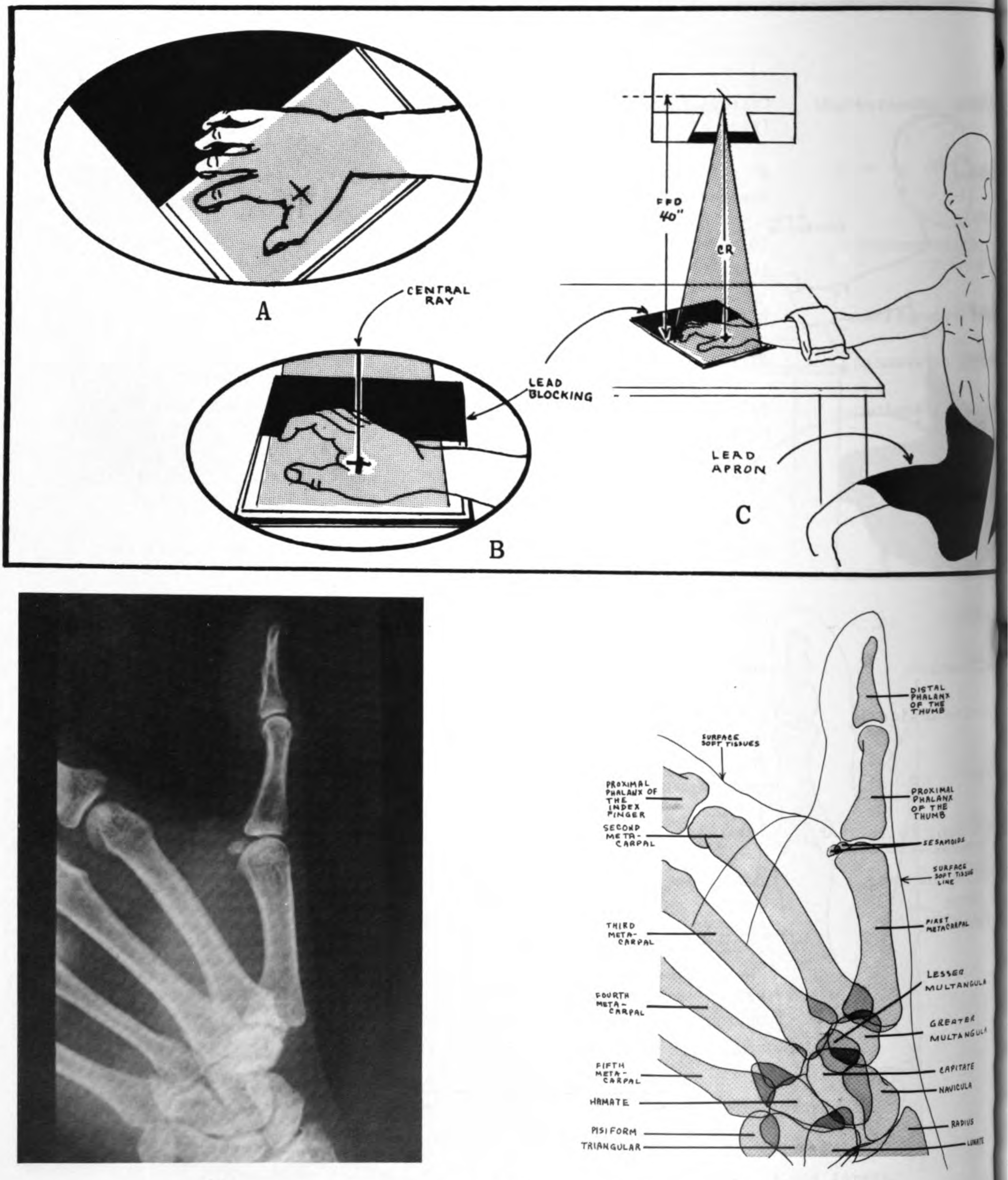


Figure 68. Thumb: Lateral



SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM S
LATERAL	2-4	100	1/10	50-55	10	40"	YES	NO	NO	0°	8" x 1
THUMB	2-4	100	1	55-60	100	40"	NO	YES	NO	0°	8" x 1

THUMB: LATERAL

ructures Demonstrated:	Lateral projection of phalanges, metacarpals and associated soft tissues (Fig. 68D and E).
lm Size:	8" x 10", crosswise, lateral third, for three views on one film.
ilm Identification:	ID marker above thumb; right or left marker next to ID marker.
atient Preparation:	Wristwatch, bracelets and rings removed.
easuring Reference:	First IP joint (Fig. 68A).
atient Positioning:	Palm of hand placed flat on table and arched until thumb in true lateral position (Fig. 68C).
art-Film Reference:	Head of first metacarpal to center of unexposed portion of film-holder (Fig. 68A).
entral Ray:	Perpendicular to film-holder, through head of first metacarpal to center of film-holder.
istance:	40 inches FFD (Fig. 68C).
mmobilization:	Sandbag on forearm (Fig. 68C).
rotective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
nstructions to Patient:	"Please do not move."
echnique Changes:	Dry or wet cast: see Glossary.
xplanations:	AP: Anterior-posterior IP: Interphalangeal joint ID: Identification marker CR: Central ray FFD: Focal-film distance Lateral: Pertaining to side

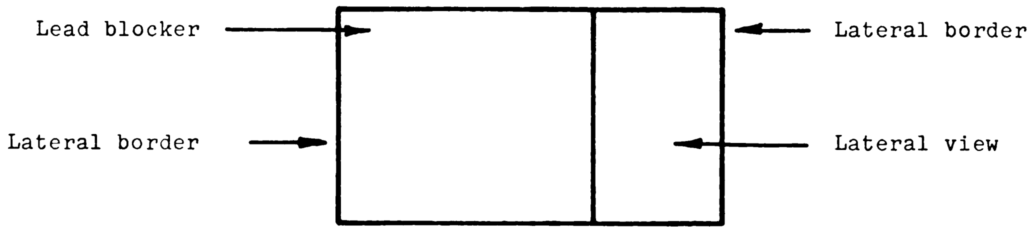
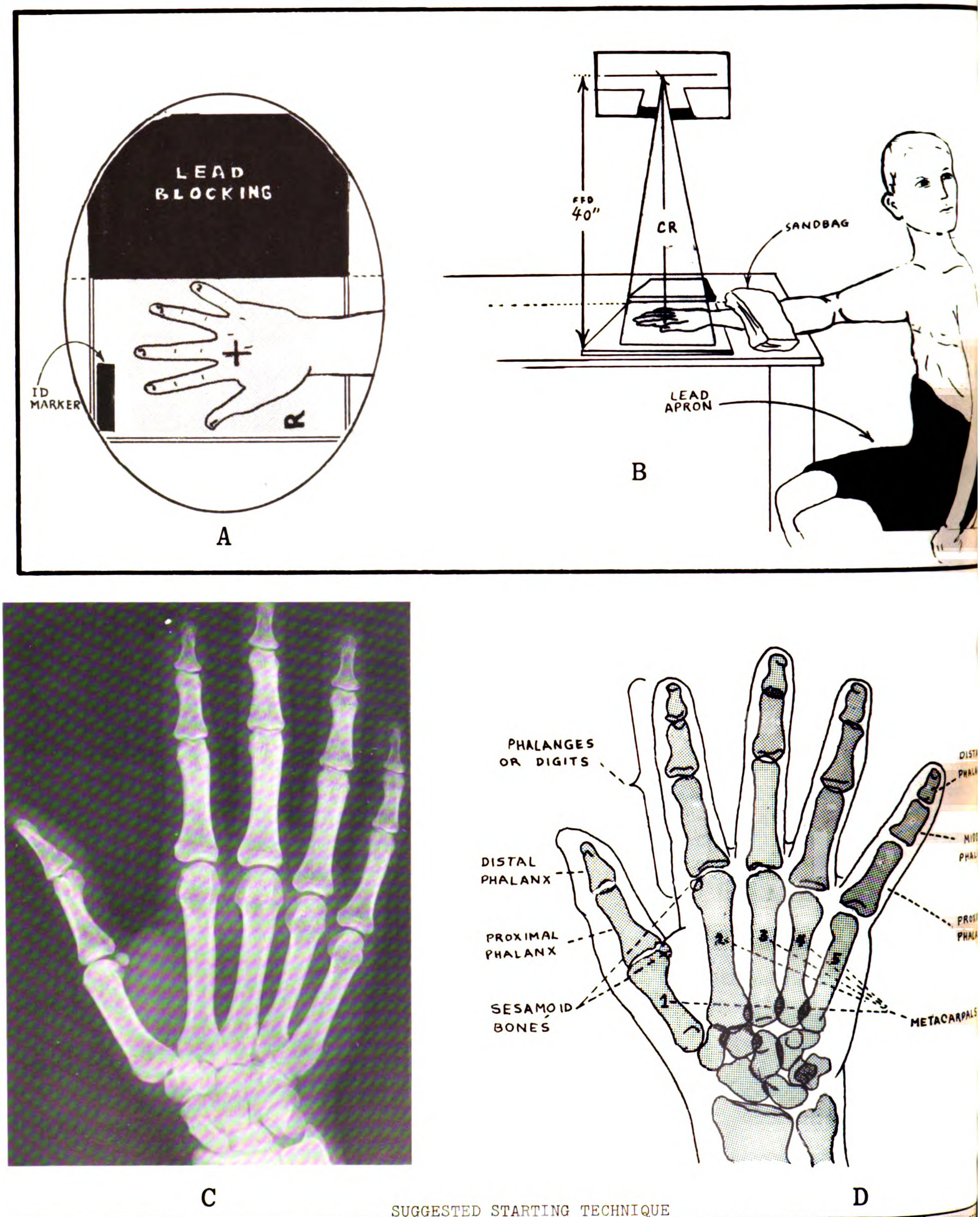


Figure 69. Hand: Posterior-Anterior



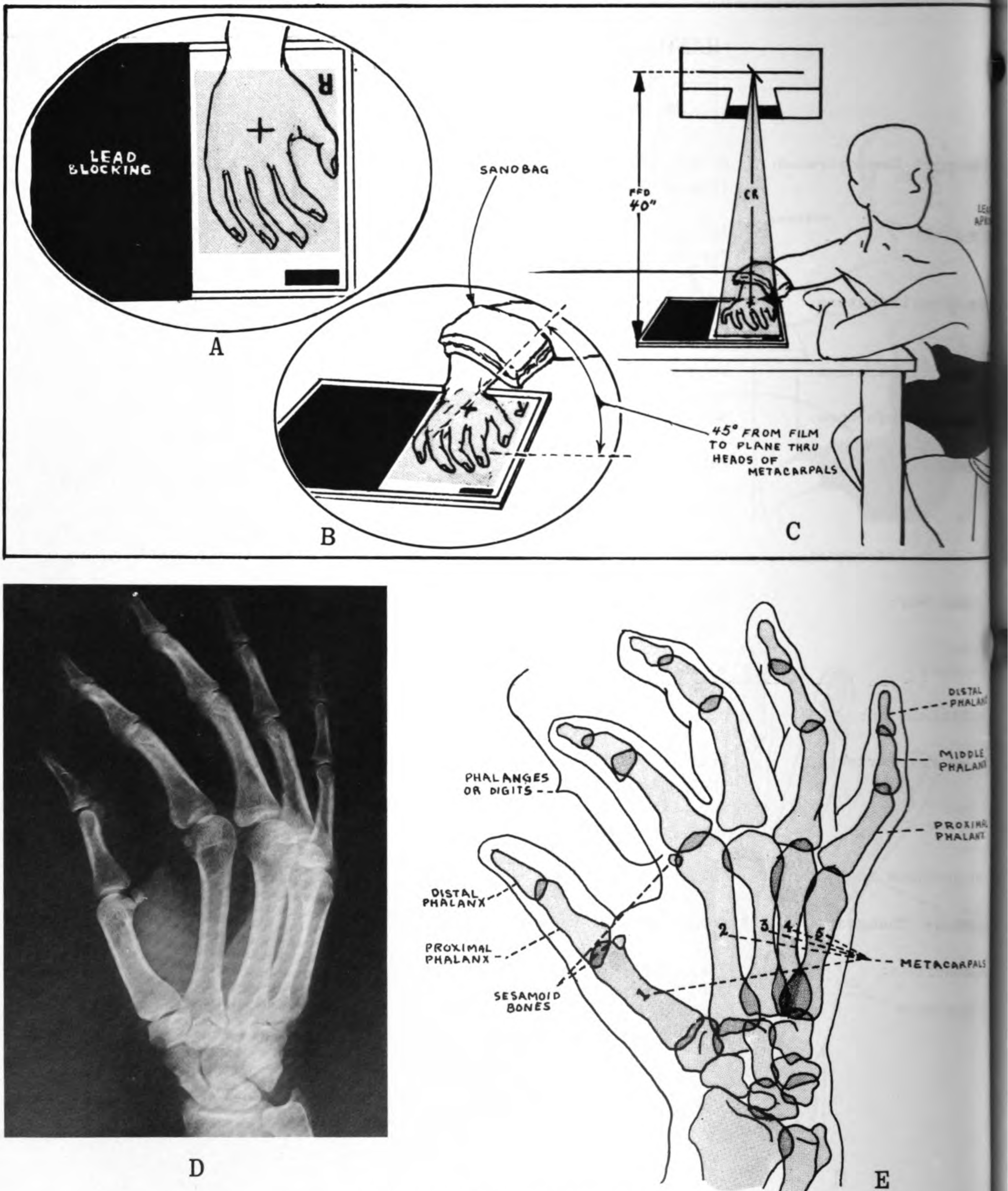
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM S
PA	2-4	100	1/10	40-50	10	40"	YES	NO	NO	0°	10" x 1
HAND	2-4	100	1	50-60	100	40"	NO	YES	NO	0°	10" x 1

HAND: POSTERIOR-ANTERIOR

ructures Demonstrated:	PA projection of phalanges, metacarpals and associated soft tissues (Fig. 69C and D).
lm Size:	10" x 12", crosswise, one-half covered with lead blocker (Fig. 69A) for two views on one film. 8" x 10", lengthwise, for single view.
lm Identification:	ID marker above fingers; right or left marker on border of film-holder (Fig. 69A).
atient Preparation:	Wristwatch, bracelets and rings removed.
easuring Reference:	Head of third metacarpal (Fig. 69A).
atient Positioning:	Patient seated close to X-ray table. Palm of hand placed on uncovered portion of film-holder, fingers extended and slightly separated (Fig. 69B).
art-Film Reference:	Head of third metacarpal to center of film-holder (Fig. 69A).
entral Ray:	Perpendicular to film-holder, through head of third metacarpal to center of film-holder (Fig. 69A and B).
istance:	40 inches FFD (Fig. 69B).
mmobilization:	Sandbag on forearm (Fig. 69B).
rotective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
nstructions to Patient:	"Please do not move."
echnique Changes:	Dry or wet cast: see Glossary.
xplanations:	PA: Posterior-anterior ID: Identification marker CR: Central ray FFD: Focal-film distance

Figure 70. Hand: Oblique



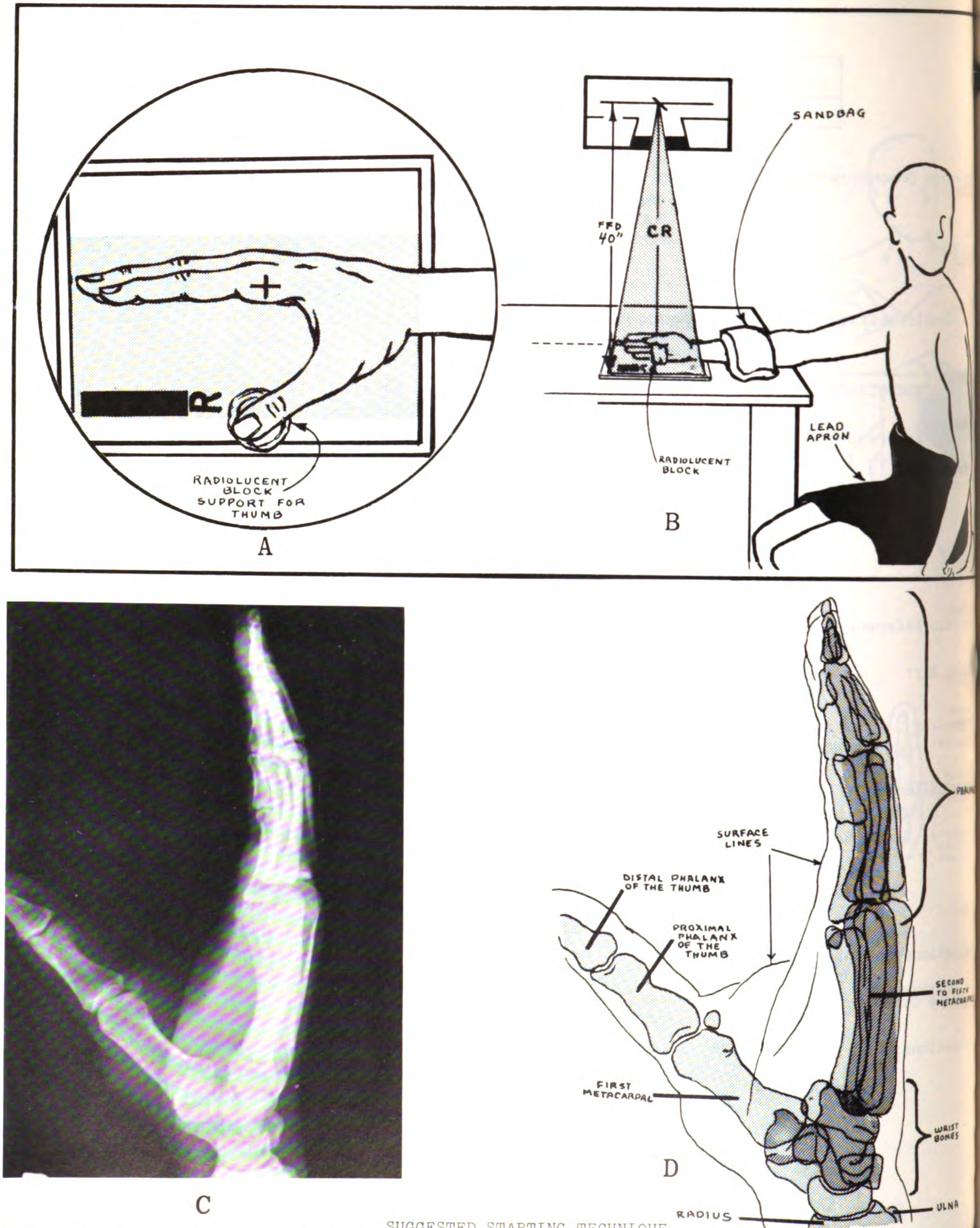
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
OBLIQUE	2-4	100	1/10	40-50	10	40"	YES	NO	NO	0°	10" x 1
HAND	2-4	100	1	50-60	100	40"	NO	YES	NO	0°	10" x 1

HAND: OBLIQUE

ructures Demonstrated:	Oblique projection of phalanges, metacarpals and associated soft tissues (Fig. 70D and E).
lm Size:	10" x 12", crosswise, one-half covered with lead blocker (Fig. 70A and B), for two views on one film.
lm Identification:	ID marker above fingers; right or left marker on border of film-holder (Fig. 70A).
atient Preparation:	Wristwatch, bracelets and rings removed.
easuring Reference:	Head of third metacarpal (Fig. 70A).
atient Positioning:	Patient seated close to X-ray table. Forearm parallel to lateral borders of film-holder. Forearm and elbow on table for support. Hand rotated so imaginary plane through heads of metacarpals forms 45° angle to film-holder. Fingers equally spaced resting on film-holder (Fig. 70C).
art-Film Reference:	Head of second metacarpal to center of film-holder.
entral Ray:	Perpendicular to film-holder, through head of second metacarpal to center of film-holder (Fig. 70A).
istance:	40 inches FFD (Fig. 70C).
mmobilization:	Sandbag on forearm (Fig. 70C).
rotective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
nstructions to Patient:	"Please do not move."
echnique Changes:	Dry or wet cast: see Glossary.
xplanations:	ID: Identification marker PA: Posterior-anterior CR: Central ray FFD: Focal-film distance Oblique: Angled half way (usually) between AP (or PA) and lateral (45° angle).

Figure 71. Hand: Lateral



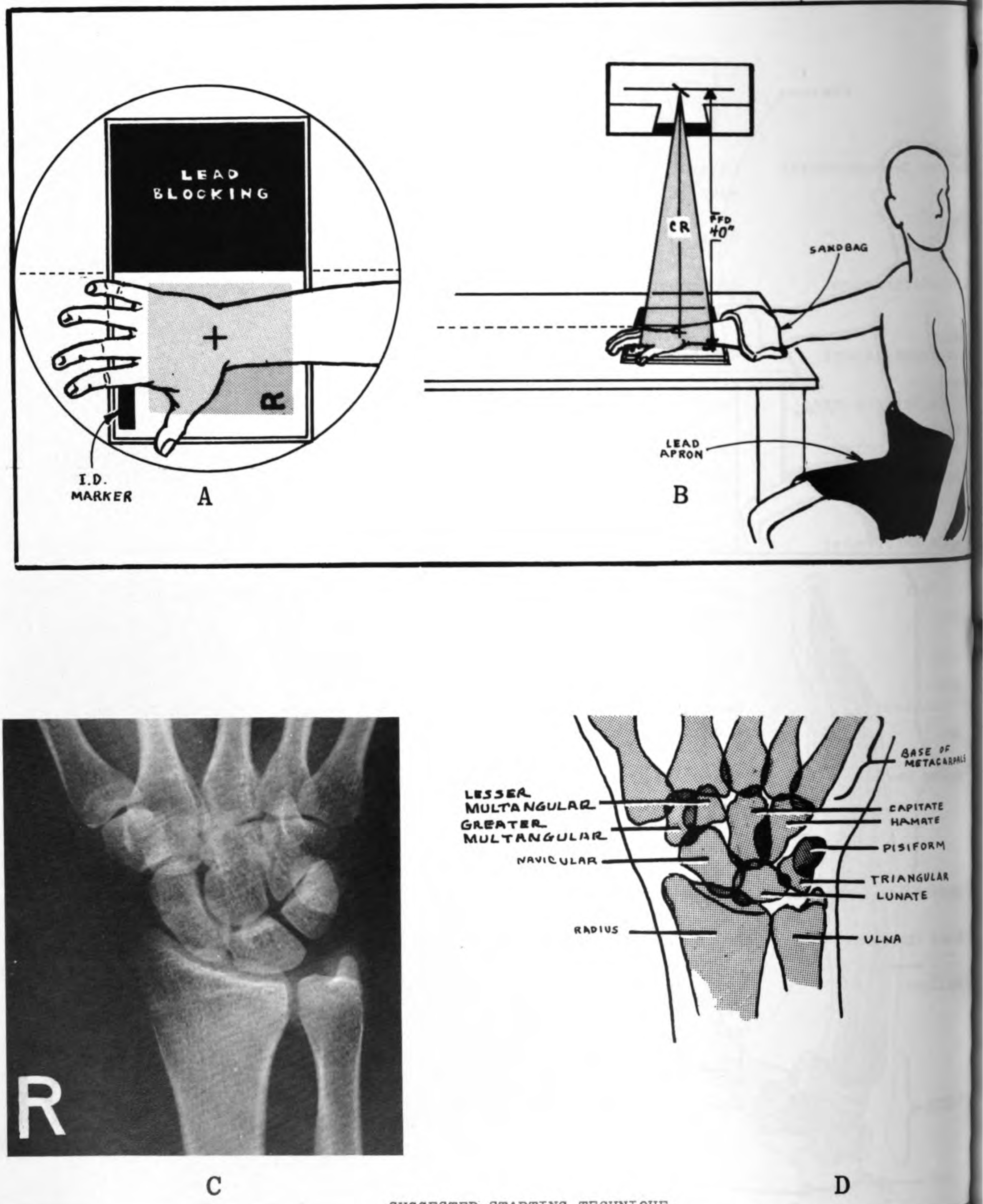
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM S
LATERAL	7-10	100	3/10	50-60	30	40"	YES	NO	NO	0°	8" x
HAND	7-10	100	3	55-65	300	40"	NO	YES	NO	0°	8" x

HAND: LATERAL

uctures Demonstrated:	Lateral projection of phalanges, metacarpals and associated soft tissues (Fig. 71C and D).
m Size:	8" x 10", lengthwise (Fig. 71A).
m Identification:	ID marker either lateral border of film-holder; right or left marker next to ID marker (Fig. 71A).
ient Preparation:	Wristwatch, bracelets and rings removed.
asuring Reference:	Hand in lateral projection, head of second metacarpal (Fig. 71A).
ient Positioning:	Patient seated close to X-ray table. Hand lengthwise on film holder, fingers extended and joined. Imaginary plane through heads of metacarpals perpendicular to film-holder (Fig. 71B).
rt-Film Reference:	Head of second metacarpal to center of film-holder (Fig. 71A).
ntral Ray:	Perpendicular to film-holder, through head of second metacarpal to center of film holder (Fig. 71B).
stance:	40 inches FFD (Fig. 71B).
mobilization:	Sandbag on forearm (Fig. 71B). Thumb supported by radiolucent positioning blocker (Fig. 71A).
otective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
structions to Patient:	"Please do not move."
chnique Changes:	Dry or wet cast: see Glossary.
planations:	AP: Anterior-posterior PA: Posterior-anterior ID: Identification marker CR: Central ray FFD: Focal-film distance Lateral: Pertaining to side.

Figure 72. Wrist: Posterior-Anterior



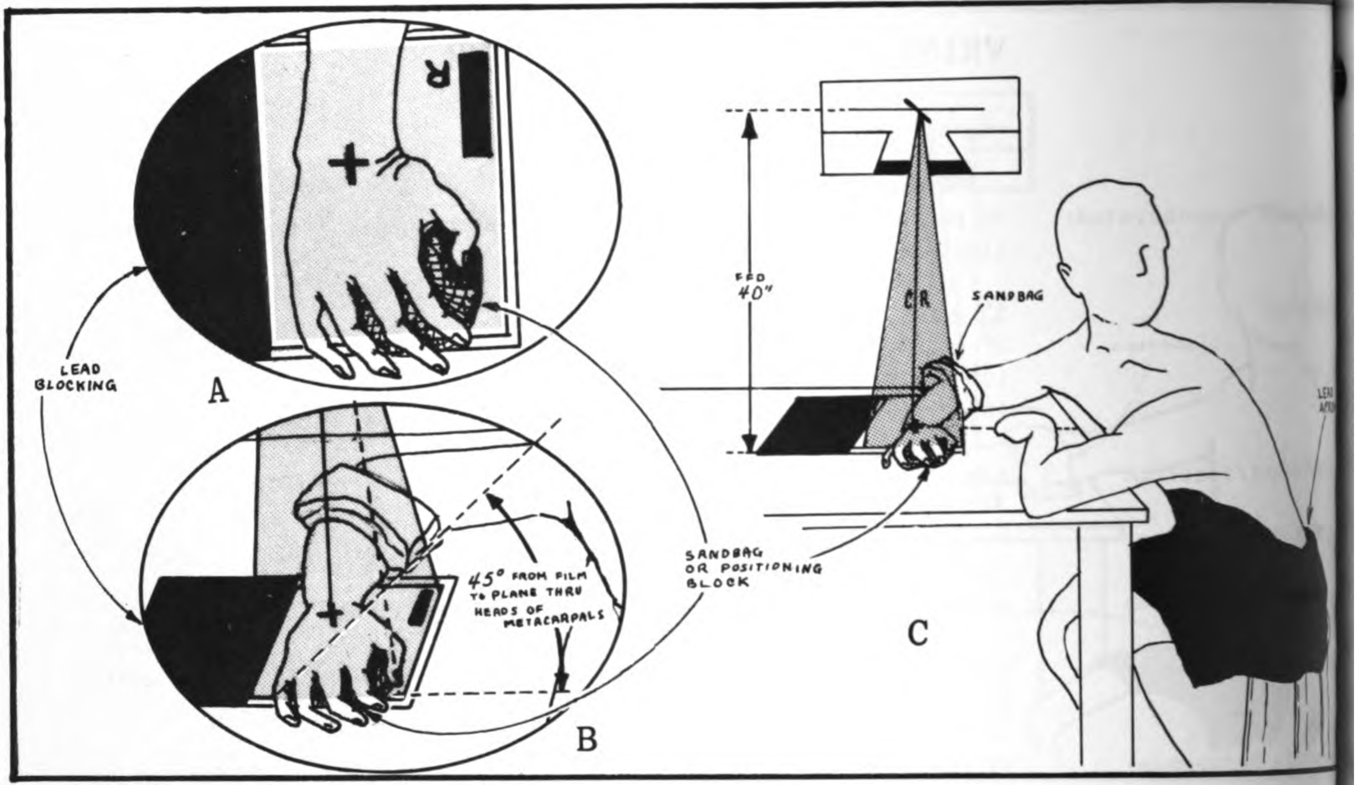
SUGGESTED STARTING TECHNIQUE

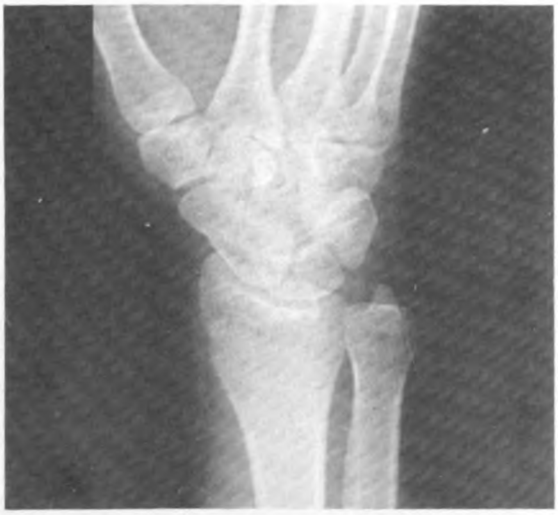
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM
PA	3-5	100	1/10	50-55	10	40"	YES	NO	NO	0°	10" x
WRIST	3-5	100	1	55-60	100	40"	NO	YES	NO	0°	10" x

WRIST: POSTERIOR-ANTERIOR

ructures Demonstrated:	PA projection of carpals, proximal metacarpals and distal radius and ulna (Fig. 72C and D).
lm Size:	8" x 10", lengthwise, for single view 8" x 10", crosswise, for two views 10" x 12", lengthwise, for three views 10" x 12", crosswise, for four views (see variations)
lm Identification:	Right or left marker on left border of film-holder (Fig. 72A).
tient Preparation:	Wristwatch, bracelets and rings removed.
asuring Reference:	Anterior surface of wrist at center of film-holder (Fig. 72A).
tient Positioning:	Patient seated close to X-ray table. Fingers flexed to bring wrist closer to film-holder. Slight ulnar deviation (Fig. 72B).
rt-Film Reference:	Midpoint of line between styloid processes to center of film-holder (Fig. 72A).
ntral Ray:	Perpendicular to film-holder, through midpoint of line between styloid processes to center of film-holder (Fig. 72A and B).
stance:	40 inches FFD (Fig. 72B).
mobilization:	Sandbag on forearm (Fig. 72B).
otective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
structions to Patient:	"Please do not move."
chnique Changes:	Dry or wet cast: see Glossary
planations:	PA: Posterior-anterior ID: Identification marker FFD: Focal-film distance Ulnar deviation: hand turned in direction of ulna.
riations:	PA and lateral views only for foreign body localization. Four views of wrist: oblique, lateral and ulnar deviation for study of fractures of navicular bone.

Figure 73. Wrist: Oblique


R
LEAD BLOCKING
A
45° FROM FILM TO PLANE THRU HEADS OF METACARPALS
B
FFD 40"
CR
SANDBAG
SANDBAG OR POSITIONING BLOCK
LEA
APR
C



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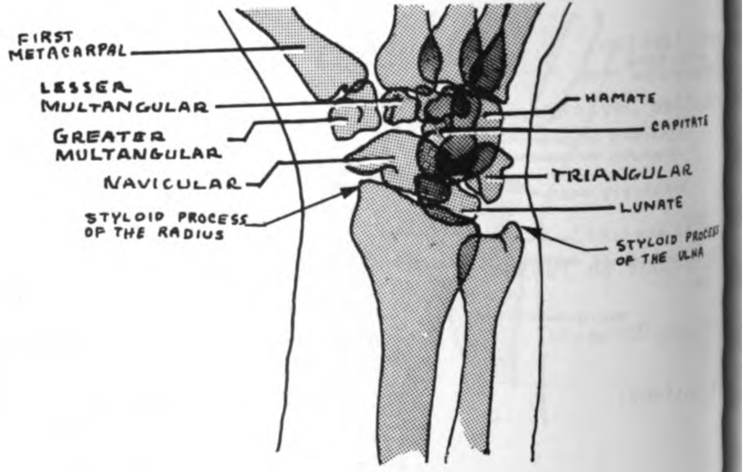


E

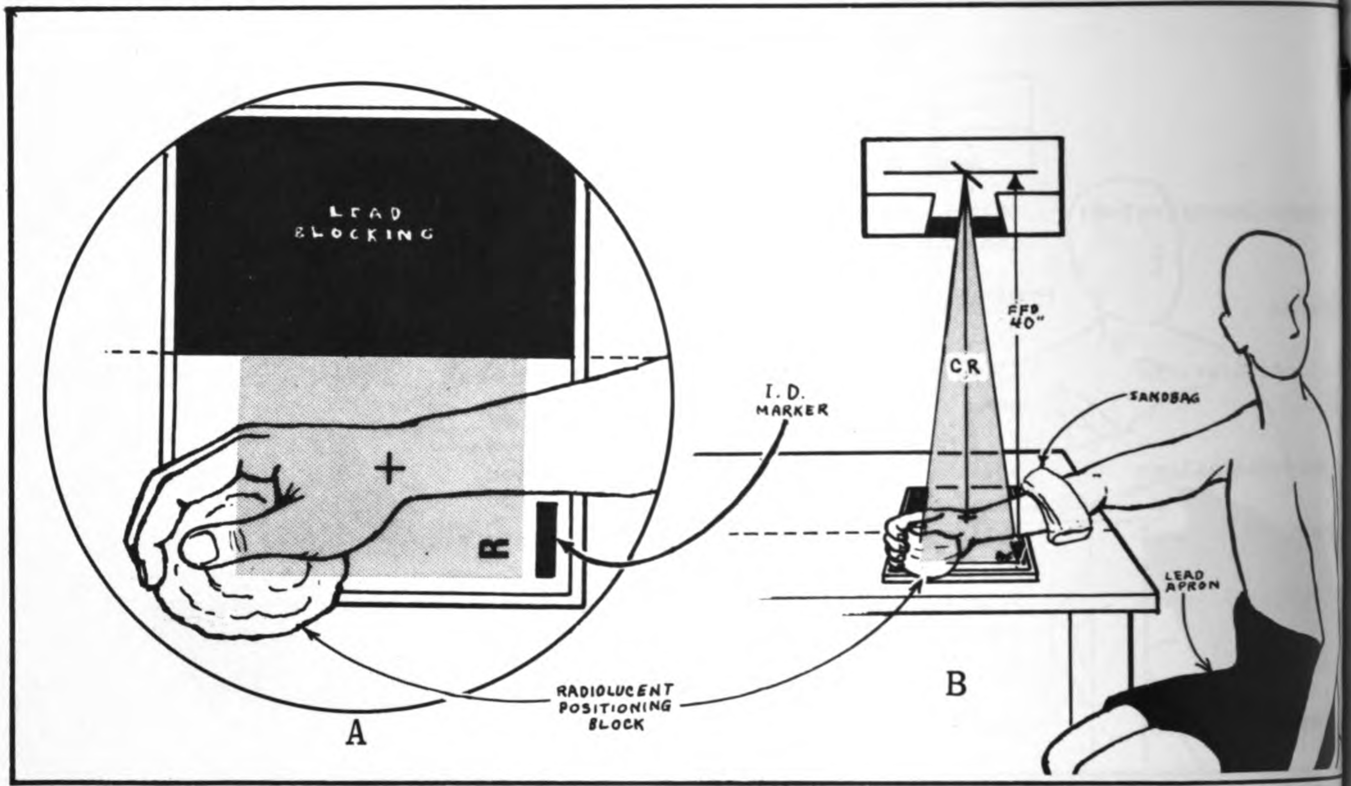
SUGGESTED STARTING TECHNIQUE

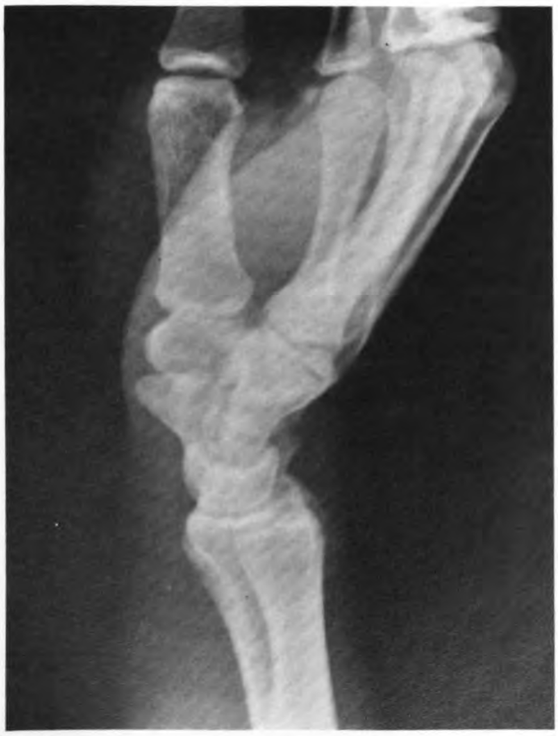
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM S
OBLIQUE	4-6	100	1/10	50-60	10	40"	YES	NO	NO	0°	10" x 1
WRIST	4-6	100	1	55-65	100	40"	NO	YES	NO	0°	10" x 1

WRIST: OBLIQUE

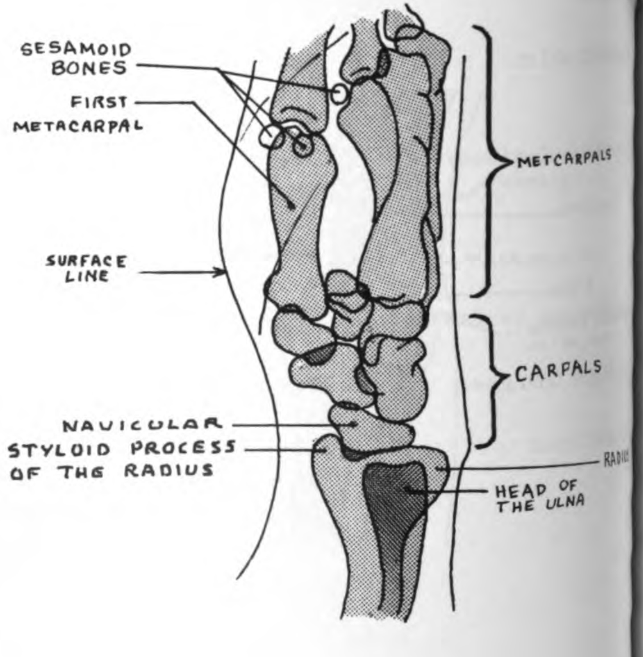
ructures Demonstrated:	Oblique projection of carpals, proximal metacarpals and distal radius and ulna (Fig. 73D and E).
lm Size:	8" x 10", lengthwise (Fig. 73A and B).
lm Identification:	ID marker above distal end of metacarpals; right or left marker on border of film-holder
tient Preparation:	Wristwatch, bracelets and rings removed.
asuring Reference:	Oblique wrist at center of film-holder (Fig. 73A).
tient Positioning:	Anterior aspect of wrist to film-holder. Hand rotated upward until imaginary plane through styloid processes at 45° angle with film-holder (Fig. 73C).
art-Film Reference:	Oblique wrist to center of film (Fig. 73A).
entral Ray:	Perpendicular to film-holder, through midpoint of line between styloid processes to center of film-holder (Fig. 73A and B).
istance:	40 inches FFD (Fig. 73C).
mmobilization:	Sandbag on upper forearm, fingers closed around another sandbag (Fig. 73C).
rotective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
nstructions to Patient:	"Please do not move."
echnique Changes:	Dry or wet cast: see Glossary.
xplanations:	ID: Identification marker FFD: Focal-film distance Oblique: Angled half way (usually) between AP (or PA) and lateral (45°).

Figure 74. Wrist: Lateral





C



D

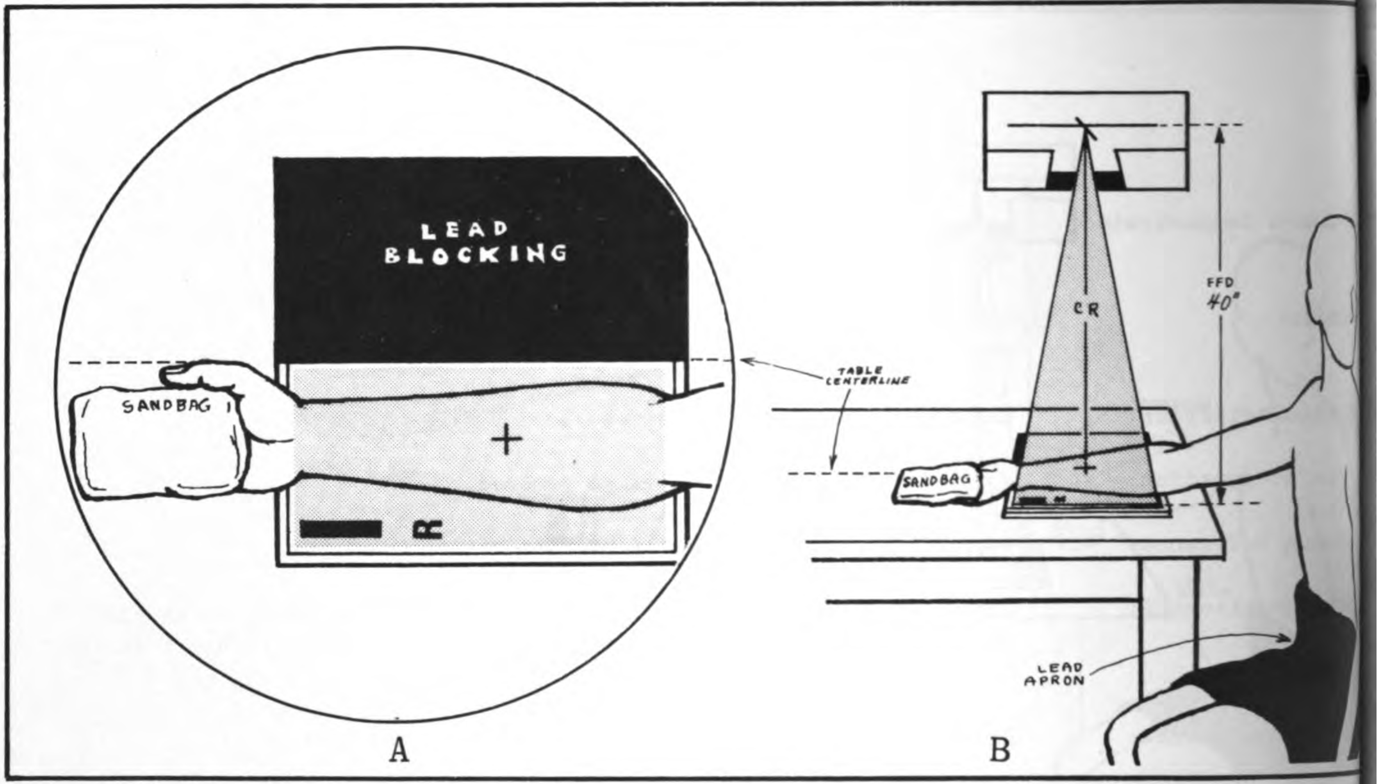
SUGGESTED STARTING TECHNIQUE

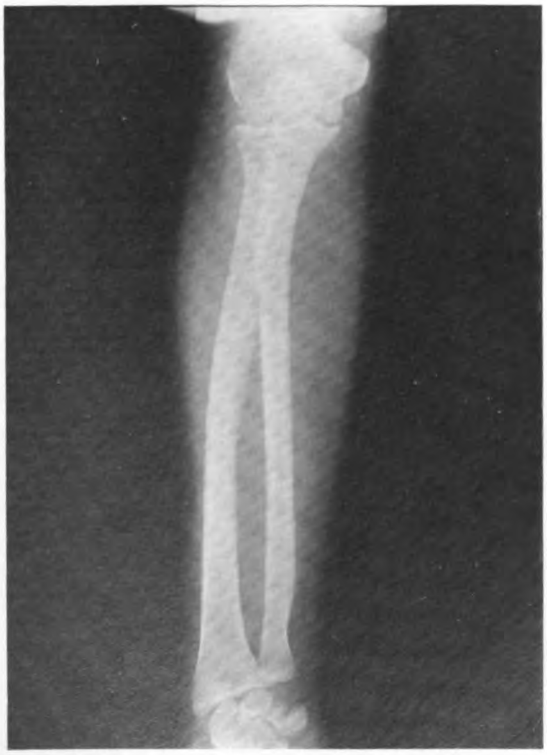
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM
LATERAL	5-8	100	1/10	55-65	20	40"	YES	NO	NO	0°	10" x
WRIST	5-8	100	1	60-70	150	40"	NO	YES	NO	0°	10" x

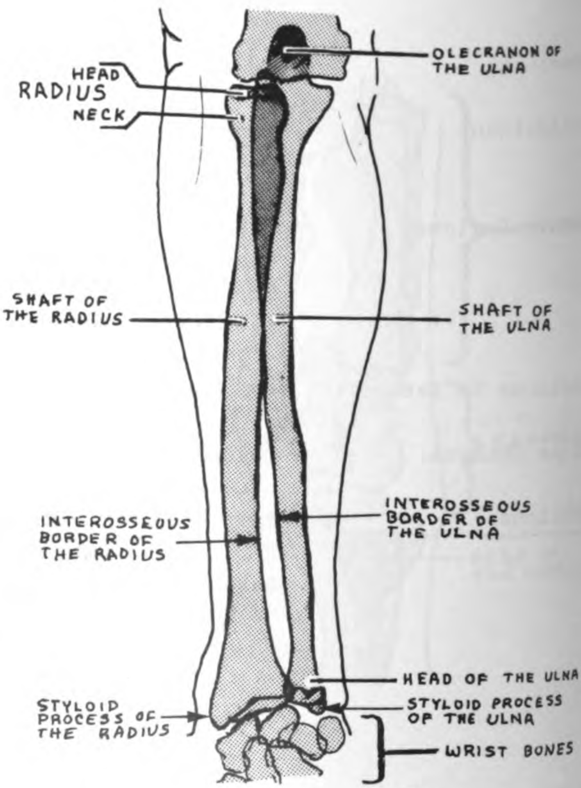
WRIST: LATERAL

Structures Demonstrated:	Lateral projection of carpal bones, metacarpals and distal radius and ulna (Fig. 74C and D).
Film Size:	10" x 12", crosswise, one-half covered with lead blocker (Fig. 74A) for two views on one film.
Film Identification:	Right or left marker on left border of film-holder (Fig. 74A).
Patient Preparation:	Wristwatch, bracelets and rings removed.
Measuring Reference:	Lateral wrist at center half of film-holder (Fig. 74A).
Patient Positioning:	Arm flexed at elbow (Fig. 74B). Medial surface of hand, wrist and forearm flush with film-holder and table. Wrist rotated until distal end of radius superimposed over head of ulna.
Part-Film Reference:	Radial styloid process to center of film-holder (Fig. 74A).
Central Ray:	Perpendicular to film-holder, through tip of radial styloid process to center of film-holder (Fig. 74A and B).
Distance:	40 inches FFD (Fig. 74B).
Immobilization:	Sandbag on upper forearm. Sandbag at palmar surface of hand (Fig. 74B).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	ID: Identification marker FFD: Focal-film distance Lateral: Pertaining to side.

Figure 75. Forearm: Anterior-Posterior






HEAD
RADIUS
NECK
OLECRANON OF THE ULNA
SHAFT OF THE RADIUS
SHAFT OF THE ULNA
INTEROSSEOUS BORDER OF THE RADIUS
INTEROSSEOUS BORDER OF THE ULNA
HEAD OF THE ULNA
STYLOID PROCESS OF THE RADIUS
STYLOID PROCESS OF THE ULNA
WRIST BONES
D

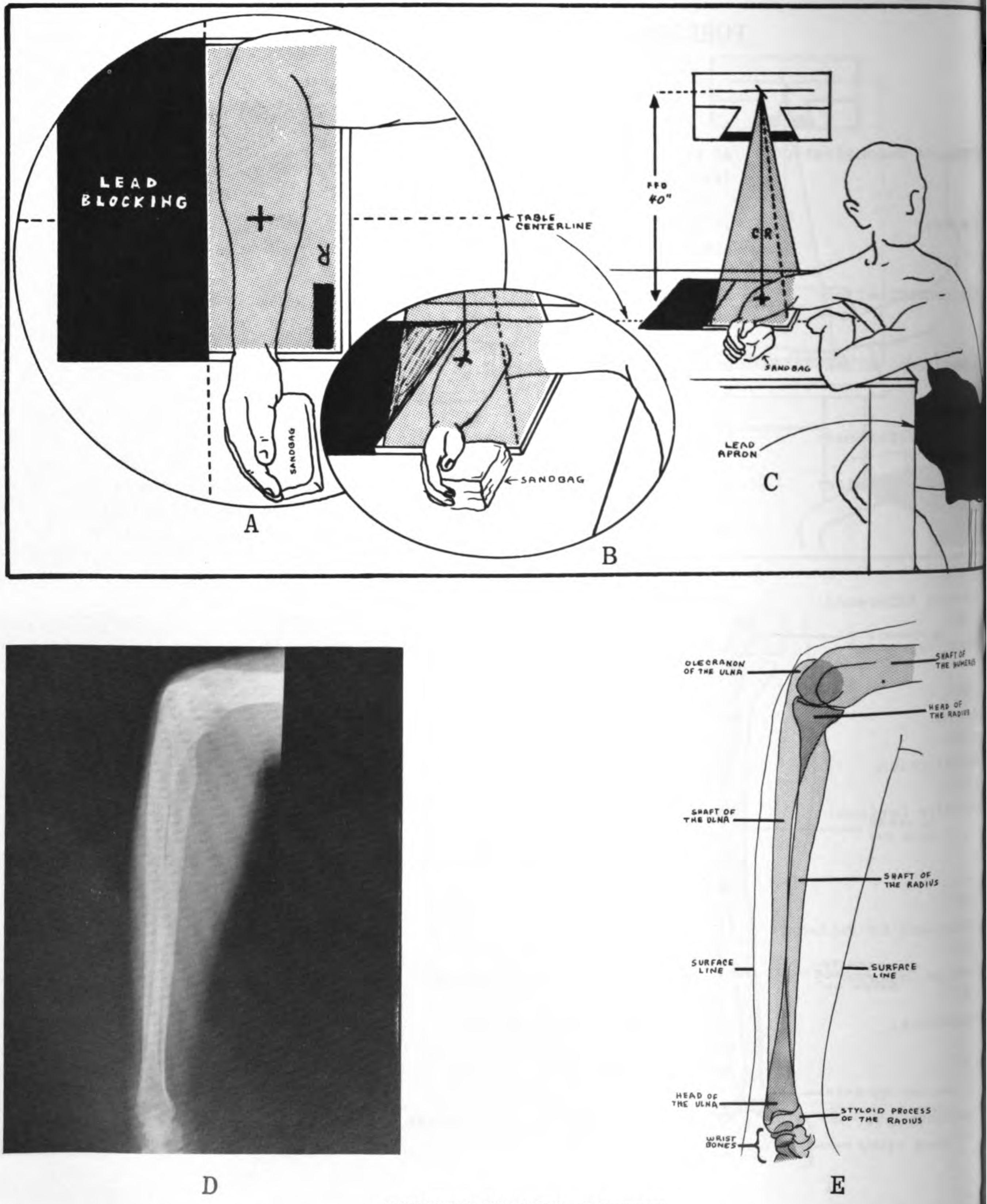
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
AP	5-8	100	1/10	55-65	10	40"	YES	NO	NO	0°	10" x 1
FOREARM	5-8	100	1	60-70	100	40"	NO	YES	NO	0°	10" x 1

FOREARM: ANTERIOR-POSTERIOR

Structures Demonstrated:	AP projection of radius, ulna, articulation nearest point of injury (Fig. 75C and D).
Film Size:	10" x 12", lengthwise, one-half of film-holder covered with a lead blocker for two views on one film (Fig. 75A).
Film Identification:	ID marker above distal end of radius (Fig. 75A); right or left marker on left border of film-holder.
Patient Preparation:	Wristwatch, all jewelry from forearm, and obstructive clothing removed.
Measuring Reference:	Midshaft of radius and ulna (Fig. 75A).
Patient Positioning:	Patient seated close to X-ray table. Posterior aspect of entire forearm closest to film-holder. Imaginary line through styloids and epicondyles parallel to film-holder. Joint nearest point of injury included (Fig. 75B).
Part-Film Reference:	Relevant portion of radius and ulna (Fig. 75A).
Central Ray:	Perpendicular to film-holder, passing through forearm to center of film-holder (Fig. 75B).
Distance:	40 inches FFD (Fig. 75B).
Immobilization:	Sandbag over fingers (Fig. 75B).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	ID: Identification marker AP: Anterior-posterior FFD: Focal-film distance
Variations:	If wrist joint included, proximal metacarpals also included. If elbow joint included, distal portion of humerus also included.

Figure 76. Forearm: Lateral



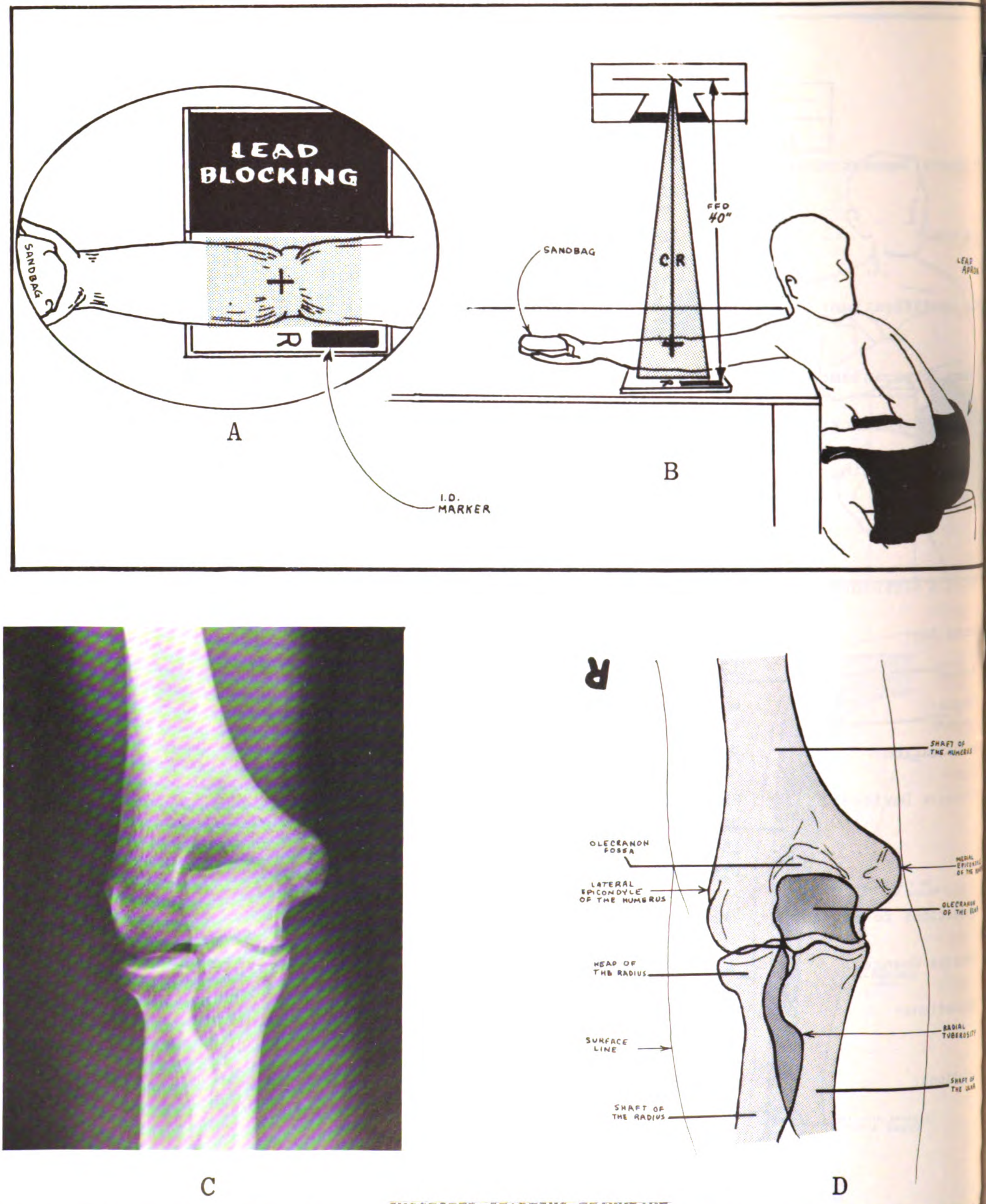
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
LATERAL	6-9	100	1/10	55-65	10	40"	YES	NO	NO	0°	10" x 1
FOREARM	6-9	100	1	60-70	100	40"	NO	YES	NO	0°	10" x 1

FOREARM: LATERAL

tructures Demonstrated:	Lateral projection of radius and ulna, with articulation nearest point of injury (Fig. 76D and E).
ilm Size:	10" x 12", lengthwise, one-half of film covered by lead blocker for two views on one film (Fig. 76B and C).
ilm Identification:	ID marker above head of ulna; right or left marker on left border of film-holder (Fig. 76A).
atient Preparation:	Wristwatch, bracelets and rings removed.
easuring Reference:	Midshaft of radius and ulna in lateral projection (Fig. 76A, B and C).
atient Positioning:	Elbow flexed 90°, medial aspect of forearm on film-holder. Distal end of radius superimposed over head of ulna, epicondyles perpendicular to film-holder. Radius and ulna aligned along center of film-holder (Fig. 76C).
art-Film Reference:	Relevant portion of forearm to center of film-holder (Fig. 76A).
entral Ray:	Perpendicular to film-holder, passing through forearm to center of film-holder (Fig. 76C).
Distance:	40 inches FFD (Fig. 76C).
Immobilization:	Fingers clutched around sandbag (Fig. 76C).
rotective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	ID: Identification marker FFD: Focal-film distance
Variations:	If wrist joint included, proximal metacarpals also included. If elbow joint included, metacarpals and radial styloid process not on film.

Figure 77. Elbow: Anterior-Posterior



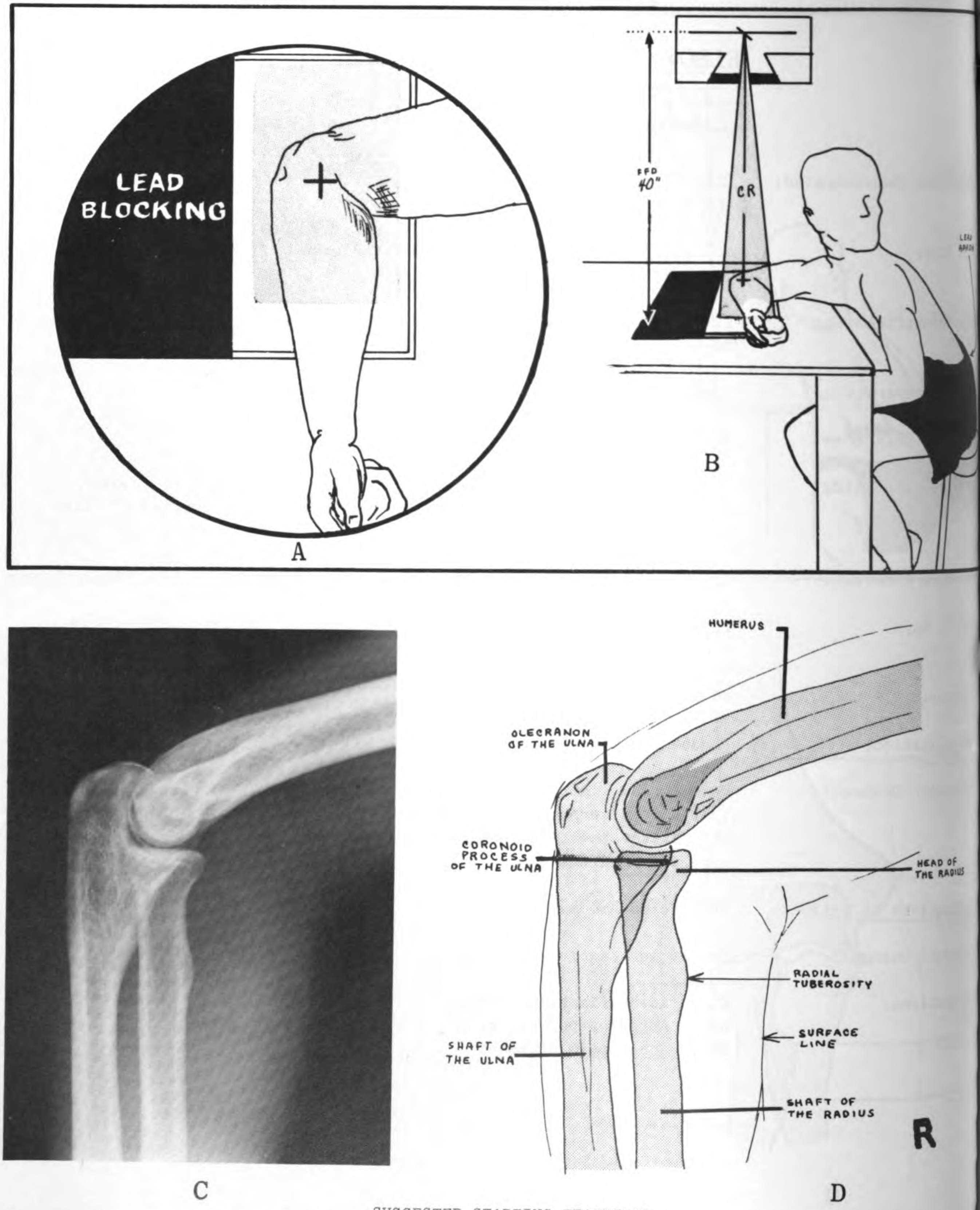
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
AP	6-9	100	1/10	55-65	10	40"	YES	NO	NO	0°	10" x 1
ELBOW	6-9	100	1	60-70	100	40"	NO	YES	NO	0°	10" x 1

ELBOW: ANTERIOR-POSTERIOR

tructures Demonstrated:	Elbow joint, proximal radius and ulna, and distal humerus (Fig. 77C and D).
ilm Size:	10" x 12", crosswise, one-half covered with lead blocker (Fig. 77A) for two views on one film.
ilm Identification:	ID marker above radius and ulna, right or left marker on left border of film-holder (Fig. 77A).
atient Preparation:	Wristwatch, bracelets and obstructive clothing removed.
easuring Reference:	Elbow joint (Fig. 77A).
atient Positioning:	Patient seated close to X-ray table. Posterior aspect of forearm lengthwise on film-holder. Epicondyles parallel to surface of film-holder (Fig. 77B).
Part-Film Reference:	Epicondyles to center of film-holder (Fig. 77A).
Central Ray:	Perpendicular to film-holder, through midpoint of line between epicondyles, to center of unexposed half of film-holder (Fig. 77A and B).
Distance:	40 inches FFD (Fig. 77B).
Immobilization:	Sandbag on hand (Fig. 77B).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	ID: Identification marker AP: Anterior-posterior FFD: Focal-film distance

Figure 78. Elbow: Lateral



SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
LATERAL	6-9	100	1/10	60-70	10	40"	YES	NO	NO	0°	10" x 1
ELBOW	6-9	100	1	65-75	100	40"	NO	YES	NO	0°	10" x 1

ELBOW: LATERAL

Structures Demonstrated: Lateral projection of proximal ends of radius and ulna, and distal end of humerus (Fig. 78C and D).

Film Size: 10" x 12", crosswise, one-half covered with a lead blocker for two views on one film. 8" x 10", lengthwise, for single view.

Film Identification: ID marker at lateral edge of film-holder; right or left marker on border of film-holder.

Patient Preparation: Wristwatch, bracelets and obstructive clothing removed.

Measuring Reference: Proximal end of humerus (Fig. 78A).

Patient Positioning: Patient seated close to X-ray table. Elbow flexed 90°. Medial surface of forearm on film-holder. Distal end of radius superimposed over head of ulna. Epicondyles perpendicular to surface of film-holder. Humerus aligned lengthwise along midline of film-holder (Fig. 78B).

Part-Film Reference: Medial epicondyle to center of film-holder (Fig. 78A).

Central Ray: Perpendicular to film-holder.

Distance: 40 inches FFD (Fig. 78D).

Immobilization: Sandbag placed in curved palm of hand (Fig. 78B).

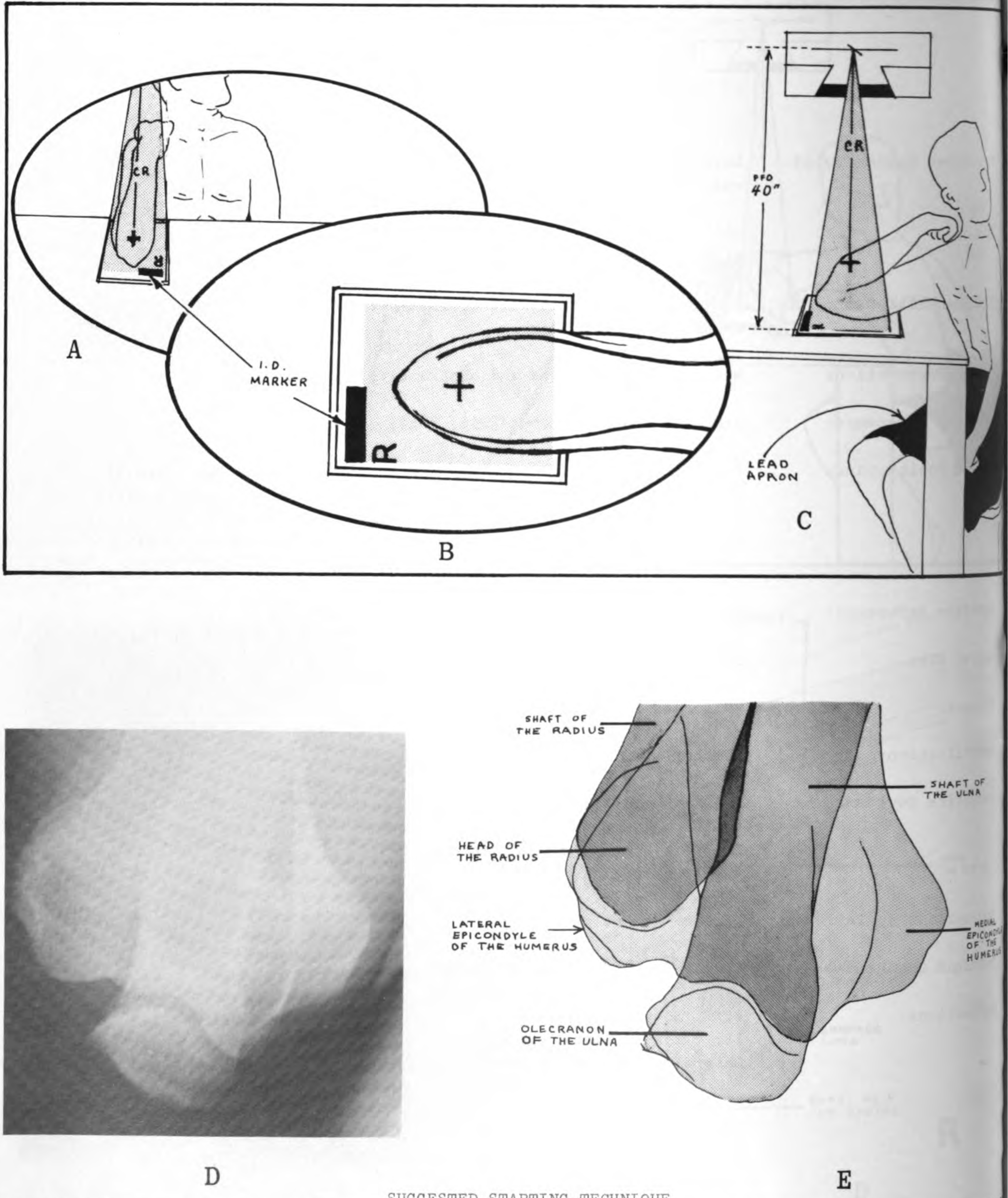
Protective Devices: Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.

Instructions to Patient: "Please do not move."

Technique Changes: Dry or wet cast: see Glossary.

Explanations:
AP: Anterior-posterior
ID: Identification marker
Lateral: Pertaining to side.

Figure 79. Elbow: Posterior-Anterior (Jones View Hyperflexed)



SUGGESTED STARTING TECHNIQUE

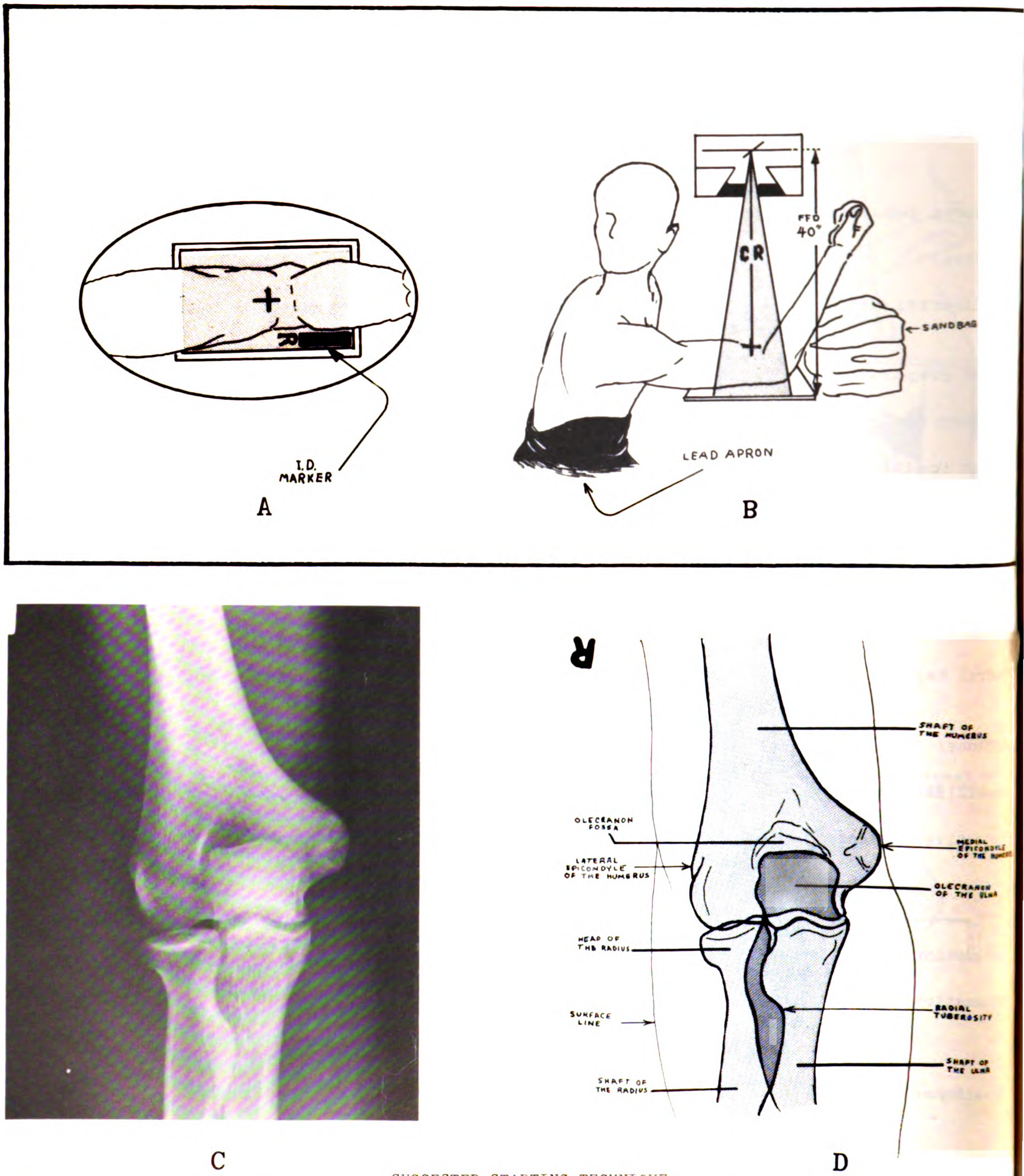
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
OLECRANON	7-11	100	1/10	55-65	10	40"	YES	NO	NO	0°	8" x 10
ELBOW JONES VIEW	7-11	100	1	60-70	100	40"	NO	YES	NO	0°	8" x 10

ELBOW: POSTERIOR-ANTERIOR

(JONES VIEW HYPERFLEXED)

Structures Demonstrated:	Olecranon process and joint space and distal humerus (Fig. 79D and E).
Film Size:	8" x 10", lengthwise (Fig. 79A).
Film Identification:	ID marker above olecranon; right or left marker on left border of film-holder (Fig. 79A).
Patient Preparation:	Obstructive clothing and jewelry removed.
Measuring Reference:	Midpoint of line between epicondyles (Fig. 79B).
Patient Positioning:	Patient seated close to X-ray table. Posterior aspect of upper arm placed on film-holder. Elbow flexed until arm and forearm are at 45° angle with each other. Midpoint of line between epicondyles over center of film-holder. Forearm rotated away from body until plane through epicondyles is parallel to surface of film-holder (Fig. 79C).
Part-Film Reference:	Posterior portion of upper arm to center of film-holder (Fig. 79A and B).
Central Ray:	Perpendicular to center of film-holder, through midpoint of line between epicondyles (Fig. 79A and B).
Distance:	40 inches FFD (Fig. 79C).
Immobilization:	Head on posterior portion of hand to help support arm (Fig. 79C).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Explanations:	PA: Posterior-anterior ID: Identification marker FFD: Focal-film distance
Variations:	Caution: do not superimpose radius and ulna, and humerus.

Figure 80. Elbow: Anterior-Posterior, For Trauma



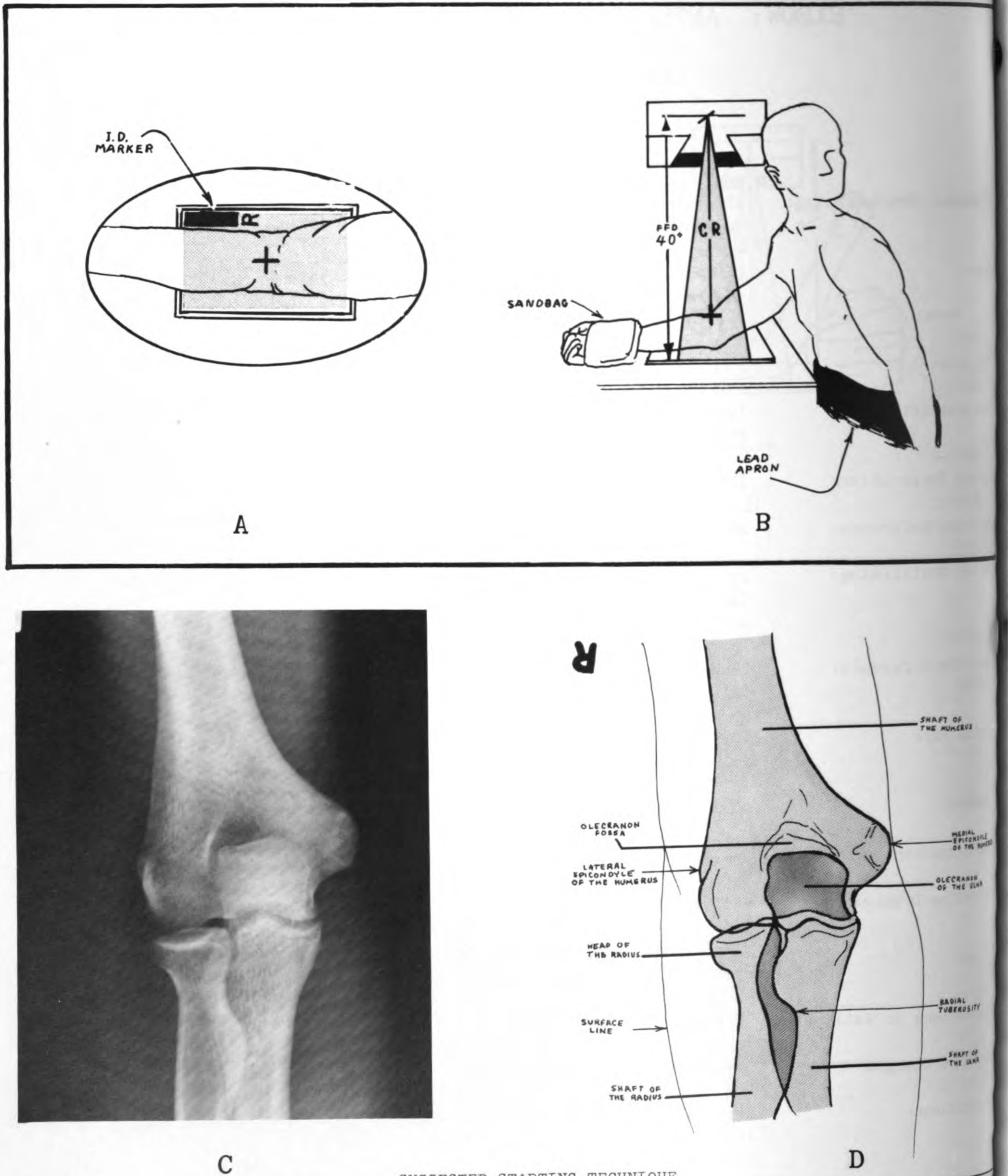
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
AP ELBOW	7-11	100	1/10	60-70	10	40"	YES	NO	NO	0°	10" x 1
PARTIAL FLEXION	7-11	100	1	65-75	100	40"	NO	YES	NO	0°	10" x 1

ELBOW: ANTERIOR-POSTERIOR, FOR TRAUMA
(PARTIAL FLEXION)

tructures Demonstrated:	AP projection of proximal ends of radius and ulna, and distal end of humerus (Fig. 80C and D).
se:	Either in addition to, or in place of, routine AP view, when arm is unable to be straightened; to supplement anterior-posterior view for routine study of elbow.
ilm Size:	8" x 10", lengthwise, for single view (Fig. 80B).
ilm Identification:	ID marker at lateral edge of film holder; right or left marker on border of film-holder (Fig. 80B).
atient Preparation:	All obstructive clothing and jewelry removed.
easuring Reference:	Anterior-posterior thickness of elbow (Fig. 80A and B).
atient Positioning:	Patient seated close to X-ray table. Posterior aspect of elbow on film-holder, with forearm flexed. Patient sits or stands so humerus and forearm are at same angle (Fig. 80B).
Part-Film Reference:	Head of the radius or olecranon process to center of film-holder (Fig. 80A and B).
Central Ray:	Vertical, bisecting angle formed by forearm and humerus, to center of film-holder (Fig. 80A and B).
Distance:	40 inches FFD (Fig. 80B).
Immobilization:	See illustration, Fig. 80A.
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	AP: Anterior-posterior ID: Identification marker FFD: Focal-film distance

Figure 81. Elbow: Anterior-Posterior, For Trauma



SUGGESTED STARTING TECHNIQUE

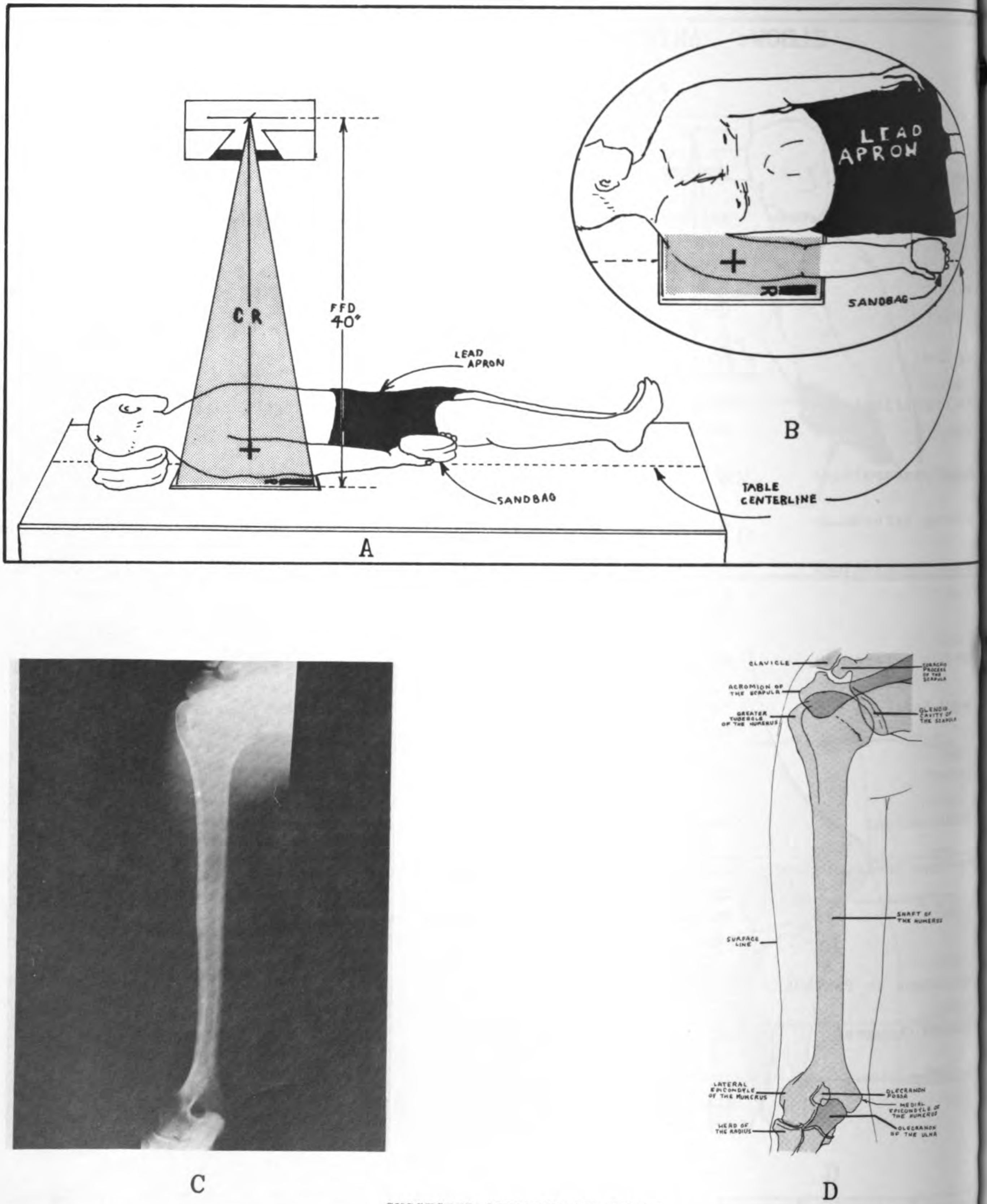
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
AP ELBOW	7-11	100	1/10	60-70	10	40"	YES	NO	NO	0°	10" x 1
PARTIAL FLEXION	7-11	100	1	65-75	100	40"	NO	YES	NO	0°	10" x 1

ELBOW: ANTERIOR-POSTERIOR, FOR TRAUMA

(PARTIAL FLEXION)

tructures Demonstrated:	AP projection of proximal ends of radius and ulna, and distal end of humerus (Fig. 81C and D).
Use:	Either in addition to, or in place of, routine AP view, when arm is unable to be straightened.
Film Size:	8" x 10", lengthwise, for single view.
Film Identification:	ID marker at lateral edge of film-holder; right or left marker on border of film-holder (Fig. 81A and B).
Patient Preparation:	All obstructive clothing and jewelry removed.
Measuring Reference:	Anterior-posterior thickness of elbow (Fig. 81A and B).
Patient Positioning:	Patient seated close to X-ray table. Posterior aspect of elbow on film-holder, with forearm flexed. Patient sits or stands so humerus and forearm are at same angle (Fig. 81B).
Part-Film Reference:	Olecranon process to center of film-holder (Fig. 81B).
Central Ray:	Vertical, bisecting angle formed by forearm and humerus, to center of film-holder (Fig. 81A and B).
Distance:	40 inches FFD (Fig. 81A).
Immobilization:	Sandbag over forearm and/or proximal wrist and forearm (Fig. 81A).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary
Explanations:	AP: Anterior-posterior ID: Identification marker FFD: Focal-film distance

Figure 82. Humerus: Anterior-Posterior



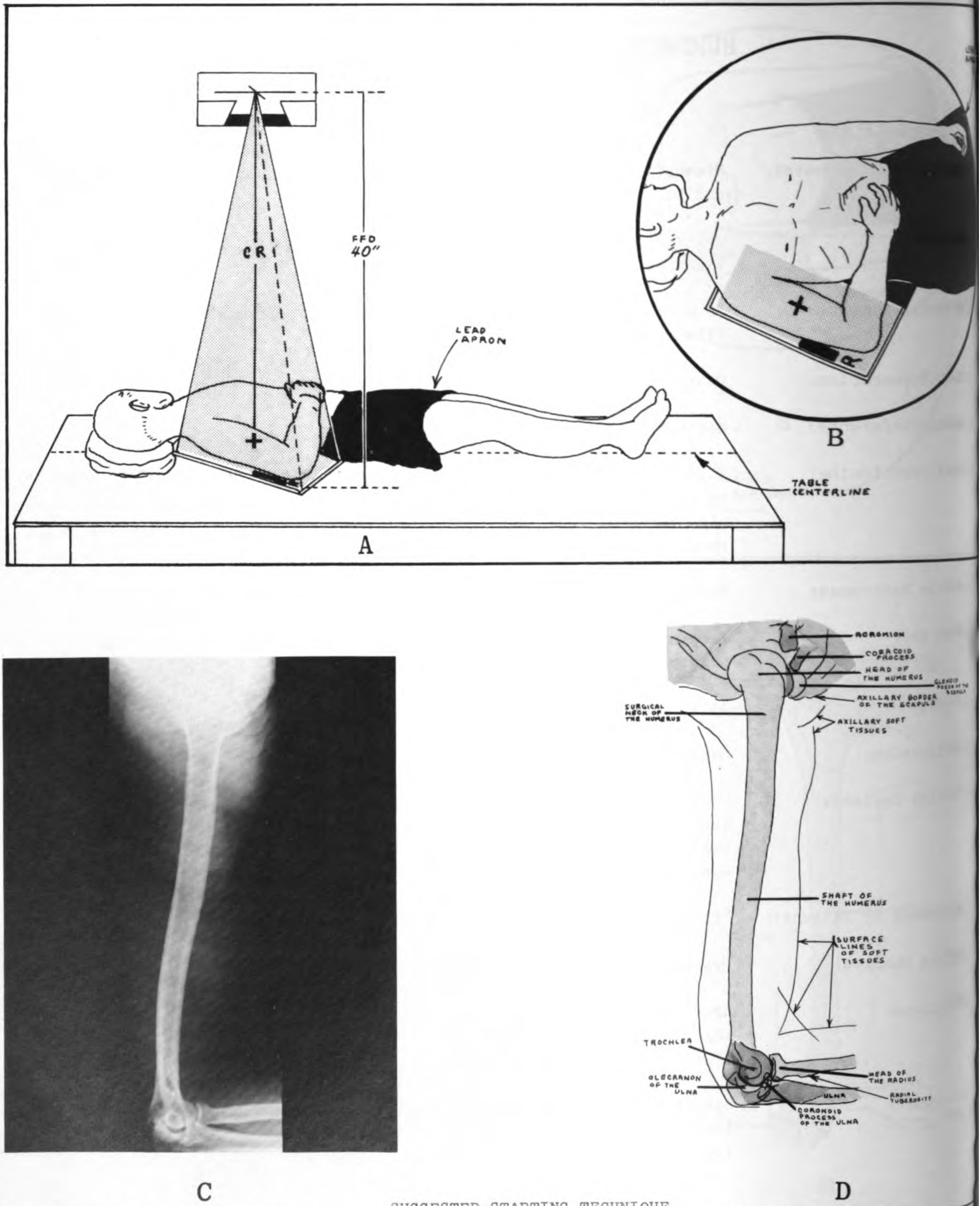
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
AP HUMERUS	8-12	100	2/10	65-75	20	40"	YES	NO	NO	0°	14" x 1

HUMERUS: ANTERIOR-POSTERIOR

tructures Demonstrated:	Midshaft and distal humerus, and proximal radius and ulna (Fig. 82C and D).
ilm Size:	14" x 17", lengthwise, one-half covered with lead blocker for two views on one film.
ilm Identification:	ID marker above radius and ulna; right or left marker on border of film-holder.
atient Preparation:	Obstructive clothing and jewelry removed.
easuring Reference:	Midshaft distal humerus (Fig. 82A).
atient Positioning:	Patient supine on X-ray table. Posterior aspect of arm and forearm extended across cassette. Elbow articulation and proximal radius and ulna included on film-holder. Line between epicondyles parallel to surface of film-holder (Fig. 82B).
art-Film Reference:	Midshaft distal humerus to center of film-holder (Fig. 82A).
entral Ray:	Perpendicular to film-holder, through humerus to center of film-holder (Fig. 82A and B).
istance:	40 inches FFD (Fig. 82B).
Immobilization:	Sandbag on hand (Fig. 82A and B).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	AP: Anterior-posterior ID: Identification marker FFD: Focal-film distance
Variations:	See routine for examination of shoulder. Caution: in routine examination of humerus, include distal joint or elbow. Proximal joint or shoulder is included in a shoulder routine.

Figure 83. Humerus: Lateral



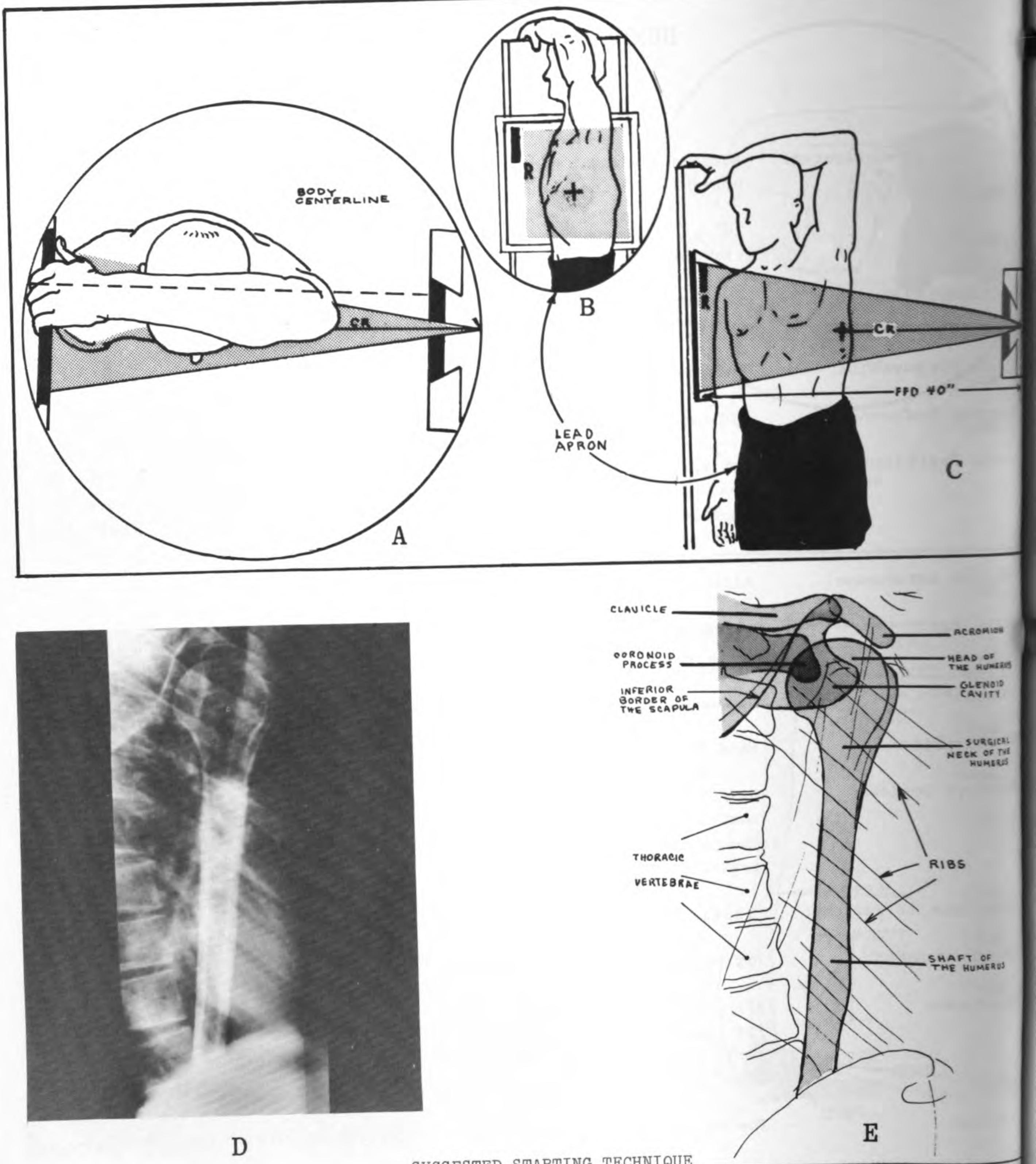
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
LATERAL HUMERUS	8-12	100	2/10	65-75	20	40"	YES	NO	YES	0°	14" x 1

HUMERUS: LATERAL

ructures Demonstrated:	Humerus, proximal ulna and radius, and elbow articulation; for upper 2/3 articulation with acromion (Fig. 83C and D).
lm Size:	14" x 17" lengthwise, one-half covered with lead blocker for two views on one film.
lm Identification:	ID marker upper border above shoulder; right or left marker on border of cassette.
atient Preparation:	Obstructive clothing removed.
easuring Reference:	Midshaft distal humerus (Fig. 83A).
atient Positioning:	Patient supine on X-ray table. Elbow flexed 90°. Medial aspect of arm and forearm placed on film-holder. Humerus centered lengthwise on film-holder, medial epicondyles on film. Forearm extended off of lateral border of film-holder (Fig. 83B).
art-Film Reference:	Midshaft distal humerus to center of film-holder (Fig. 83A).
entral Ray:	Perpendicular to film-holder through humerus to center of film-holder (Fig. 83A and B).
istance:	40 inches FFD (Fig. 83B).
mmobilization:	Hand PA; sandbag on back of hand (Fig. 83B).
rotective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
nstructions to Patient:	"Please do not move."
echnique Changes:	Dry or wet cast: see Glossary.
xplanations:	AP: Anterior-posterior PA: Posterior-anterior ID: Identification marker FFD: Focal-film distance
ariations:	The humerus through thorax. See transthoracic view of the humerus.

Figure 84. Humerus: Lateral (Transthoracic)



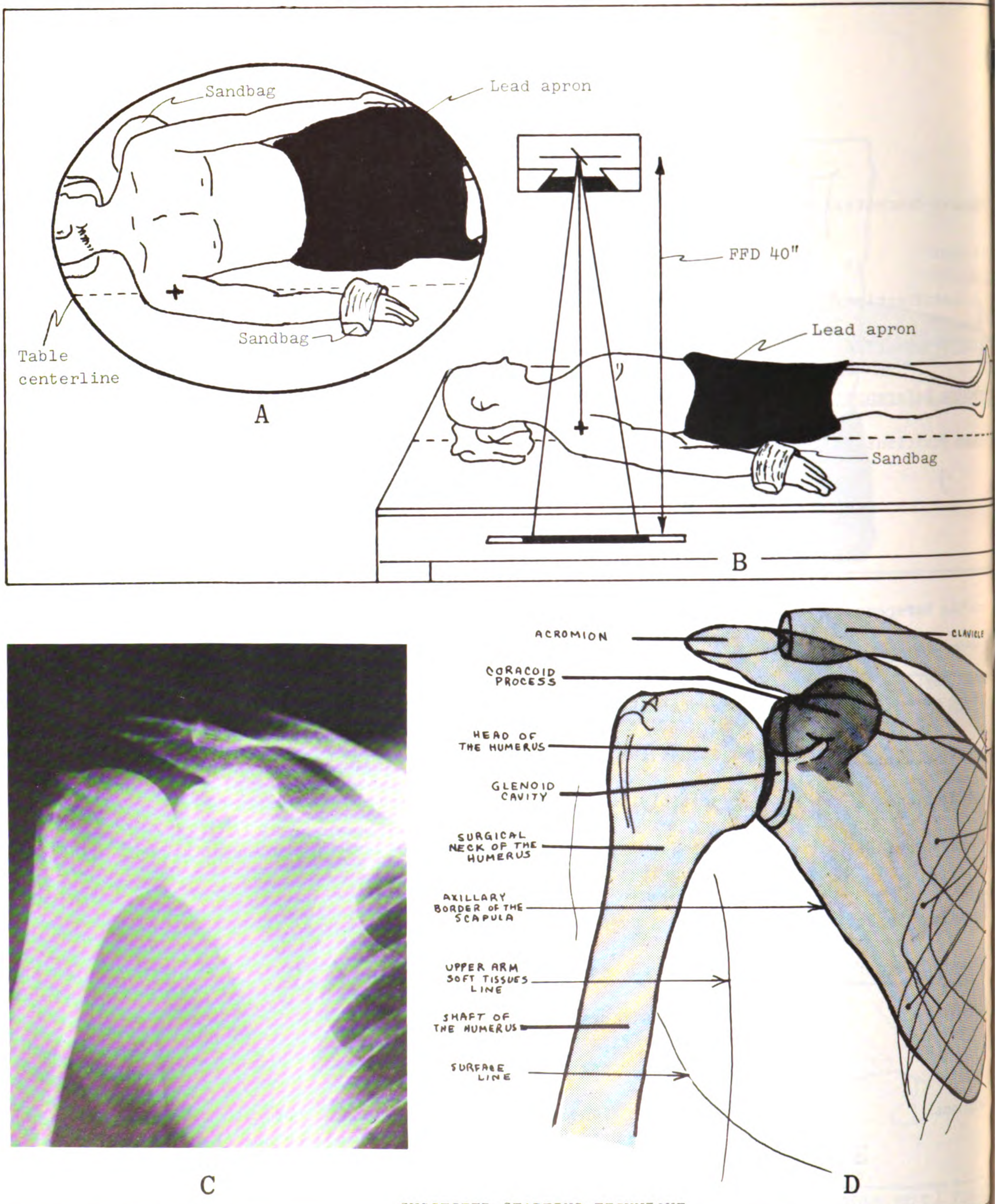
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
LATERAL HUMERUS TRANS-THORACIC	35-40	100	1	85-95	100	40"	YES	NO	YES	90°	14" x 1

HUMERUS: LATERAL, FOR TRAUMA
(TRANSTHORACIC)

ructures Demonstrated:	Proximal humerus in lateral position (Fig. 84D and E).
lm Size:	14" x 17" lengthwise in Bucky tray for single view (Fig. 84C).
ilm Identification:	ID marker, right or left marker on border of cassette (Fig. 84A).
atient Preparation:	All obstructive clothing removed.
easuring Reference:	Lateral thickness of chest (Fig. 84A and C).
atient Positioning:	Patient upright in true lateral position, affected arm nearest cassette (upright table), Bucky or grid. Epicondyles and styloid processes of injured extremity perpendicular to cassette. Opposite arm raised over head. Cassette (in Bucky tray or not) centered at point two inches inferior to acromion process (Fig. 84C). Caution: exposure is made on inspiration.
art-Film Reference:	Lateral surface of upper arm at center of cassette, upright table or Bucky (Fig. 84C).
entral Ray:	Perpendicular through point two inches inferior to acromion process, to center of cassette (Fig. 84B and C).
istance:	40 inches FFD (Fig. 84C).
mmobilization:	If possible, compression band supporting patient's body.
rotective Devices:	Useful beam limited to area of interest. It is suggested that a lead apron be tied around waist to protect gonads.
nstructions to Patient:	"Take in a deep breath. Hold your breath in. Do not move."
echnique Changes:	Add 3 kVp for each additional cm.
xplanations:	ID: Identification marker FFD: Focal-film distance Bucky tray, Bucky diaphragm: see Glossary.
ariations:	Radiographs of the shoulder may be accomplished with less discomfort to the patient in the erect position by making use of an upright Bucky or a stationary grid.

Figure 85. Shoulder: Anterior-Posterior (Internal Rotation)



SUGGESTED STARTING TECHNIQUE

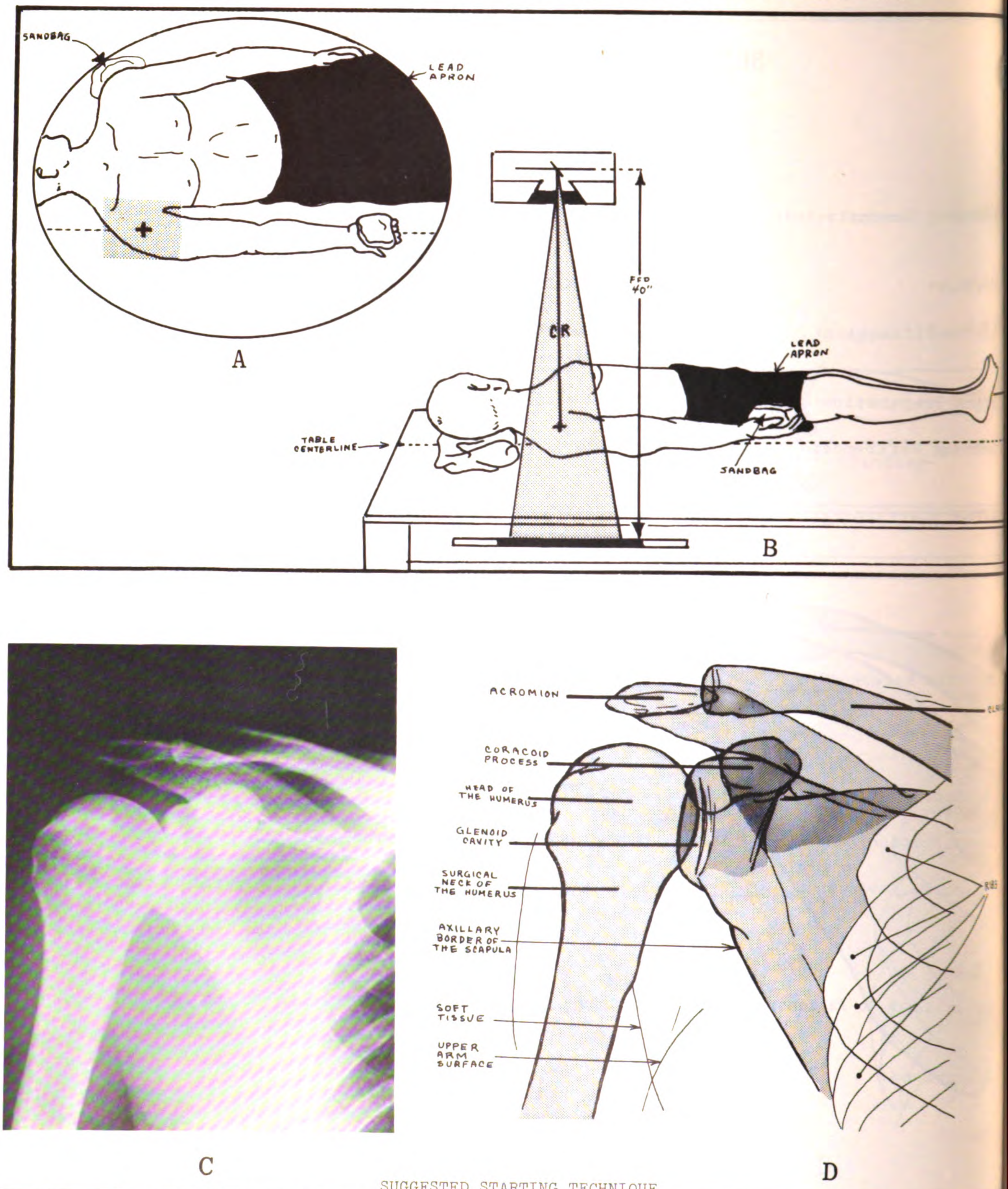
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
AP SHOULDER INTERNAL ROTATION	11-15	100	1	75-85	100	40"	YES	NO	YES	0°	10" x 1

SHOULDER: ANTERIOR-POSTERIOR

(INTERNAL ROTATION)

ructures Demonstrated:	Proximal third of humerus, coracoid process, glenoid fossa and articulating surfaces of scapula (Fig. 85C and D).
ilm Size:	10" x 12", crosswise, in Bucky tray (Fig. 85B).
ilm Identification:	ID marker on upper border above shoulder; right or left marker on border of cassette.
atient Preparation:	All obstructive clothing removed.
easuring Reference:	Anterior-posterior thickness of shoulder at coracoid process (Fig. 85A).
atient Positioning:	Patient in supine position on X-ray table; coracoid process of affected shoulder over center line of table. Opposite shoulder slightly elevated by sand bag. Palm of hand in pronation (see Glossary) rotated downward until epicondyles are perpendicular to table top. Elbow flexed slightly. Coracoid process placed over center of cassette in Bucky tray (Fig. 85A and B).
art-Film Reference:	Lateral end of clavicle to center of cassette (Fig. 85A).
entral Ray:	Perpendicular through coracoid process to center of cassette (Fig. 85B).
istance:	40 inches FFD (Fig. 85B).
Immobilization:	Sandbag placed on back of hand (Fig. 85A and B).
Protective Devices:	Useful beam limited to area of interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Take in a deep breath. Hold your breath in. Do not breathe or move."
Explanations:	AP: Anterior-posterior ID: Identification marker FFD: Focal-film distance Bucky tray: see Glossary

Figure 86. Shoulder: Anterior-Posterior (External Rotation)



SUGGESTED STARTING TECHNIQUE

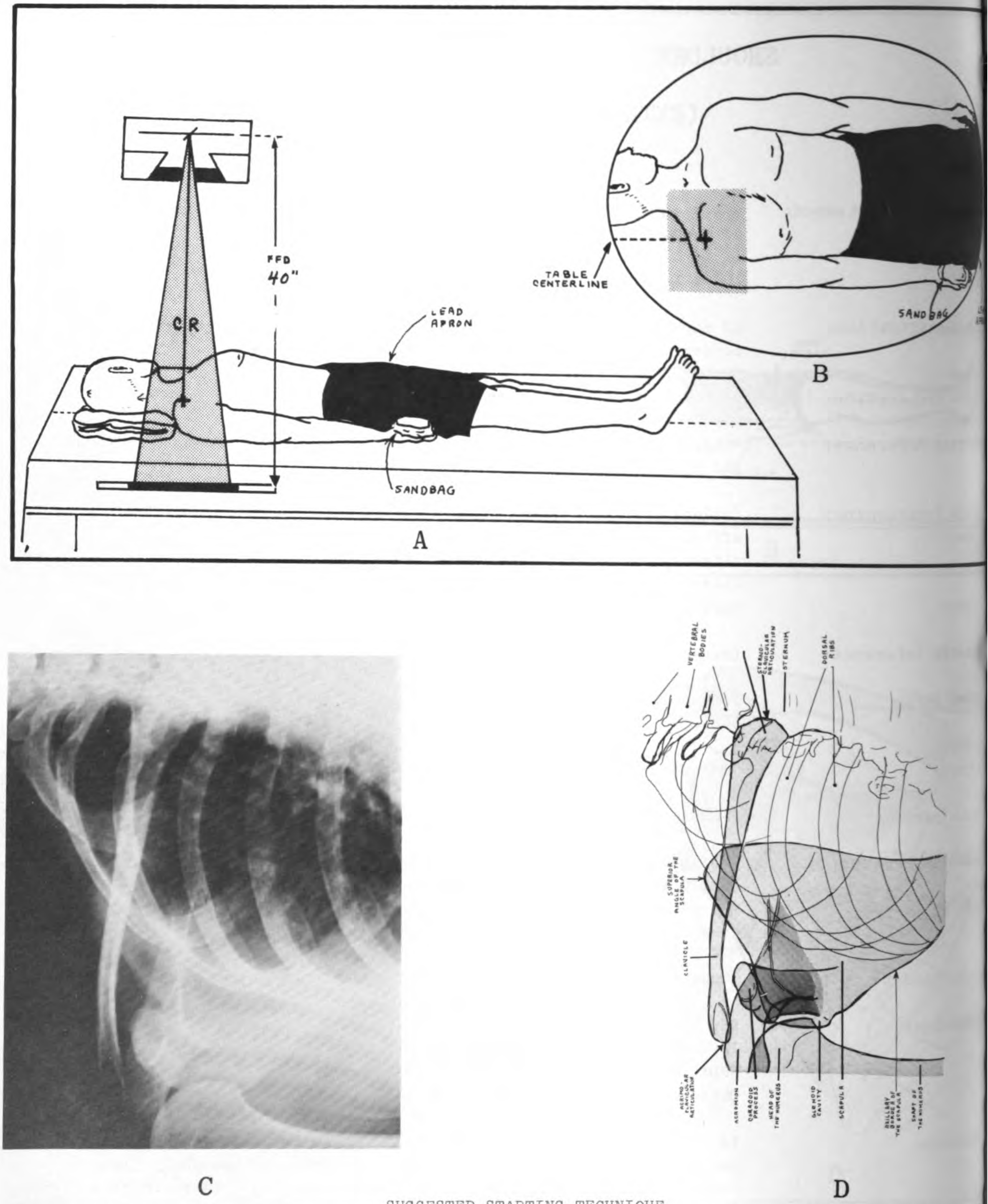
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
AP SHOULDER EXTERNAL ROTATION	11-15	100	1	75-85	100	40"	YES	NO	YES	0°	10" x 1

SHOULDER: ANTERIOR-POSTERIOR

(EXTERNAL ROTATION)

ructures Demonstrated:	Coracoid process, lateral end of clavicle and articulating surfaces of scapula (Fig. 86C and D).
lm Size:	10" x 12", crosswise, in Bucky tray.
lm Identification:	ID marker on upper border above shoulder; right or left marker on border of cassette.
tient Preparation:	All obstructive clothing removed.
asuring Reference:	Anterior-posterior thickness of shoulder at glenoid fossa (Fig. 86A and B).
tient Positioning:	Patient in supine position on X-ray table. Coracoid process of affected shoulder over center line of table. Opposite shoulder slightly elevated by sandbag. Palm of hand in supination (see Glossary) rotated upward until epicondyles parallel to table top. Coracoid process placed over center of cassette in Bucky tray (Fig. 86B).
art-Film Reference:	Coracoid process at center of cassette (Fig. 86A).
entral Ray:	Perpendicular, through coracoid process, to center of cassette (Fig. 86B).
istance:	40 inches FFD (Fig. 86B).
mmobilization:	Sandbag placed against palm of hand (Fig. 86A and B).
rotective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
nstructions to Patient:	"Take in a deep breath. Hold your breath in. Do not breathe or move."
xplanations:	AP: Anterior-posterior ID: Identification marker FFD: Focal-film distance Bucky tray: see Glossary
ariations:	If patient unable to lie supine, tilt table in upright position so patient stands with back against table. Same factors apply. With young, or small adult patients, Bucky is not used; cassette placed on table top, or in vertical, upright film-holder.

Figure 87. Clavicle: Anterior-Posterior



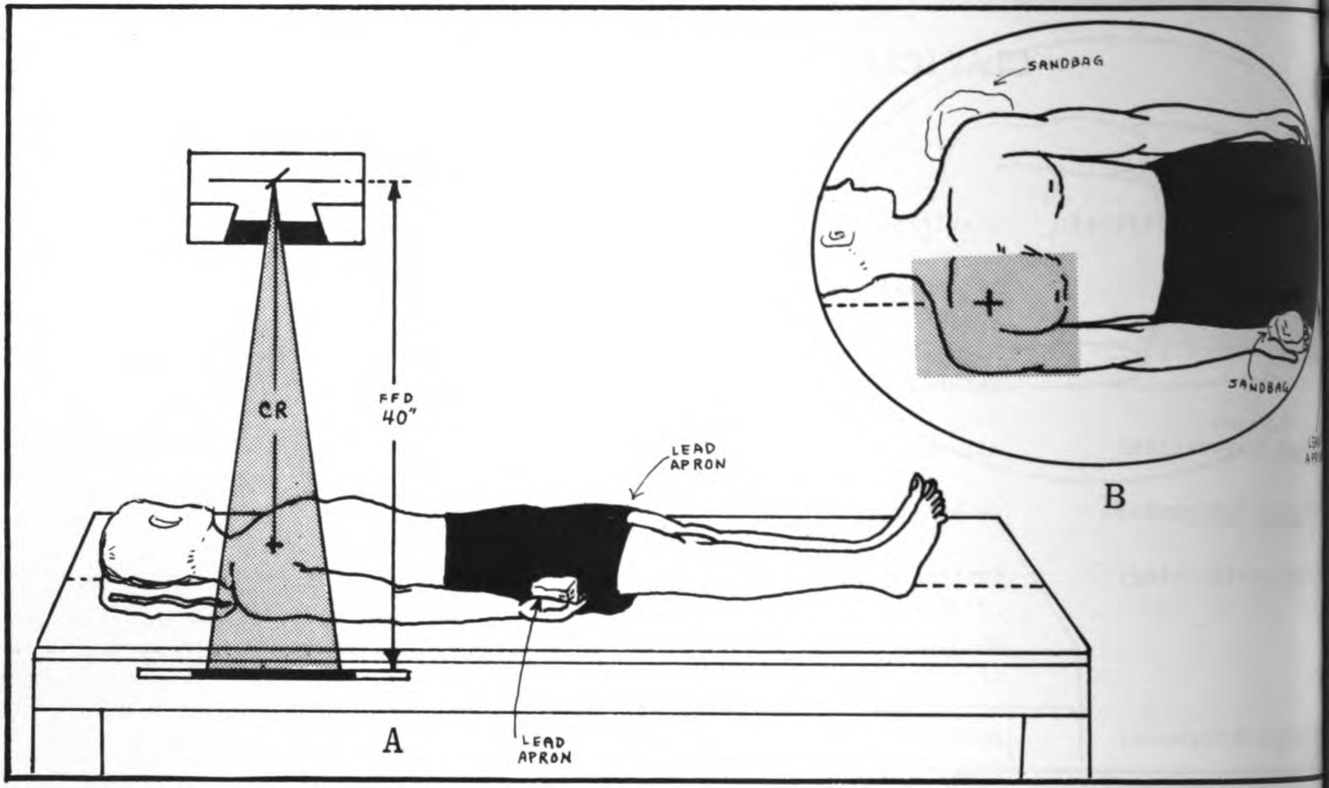
SUGGESTED STARTING TECHNIQUE

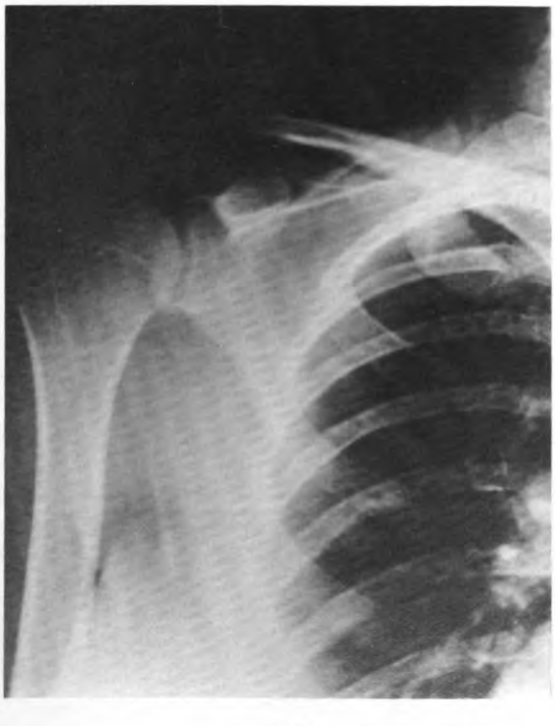
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
AP CLAVICLE	11-15	100	1	70-80	100	40"	YES	NO	YES	0°	10" x 1

CLAVICLE: ANTERIOR-POSTERIOR

ructures Demonstrated:	Clavicle and its articulation (Fig. 87C and D).
lm Size:	10" x 12", crosswise, in Bucky tray.
lm Identification:	ID marker on upper border above shoulder; right or left marker on lateral border of cassette.
tient Preparation:	All obstructive clothing removed.
asuring Reference:	AP thickness of shoulder (Fig. 87B).
tient Positioning:	Patient in supine position on X-ray table. Arms at sides. Midpoint of clavicle over center line of table. Slight elevation of opposite shoulder places clavicle closer to recording surface. Upper border of cassette 2" above clavicle (Fig. 87A).
rt-Film Reference:	Posterior portion of body, under clavicle, at center of cassette (Fig. 87B).
ntral Ray:	Perpendicular to center of cassette (Fig. 87A).
stance:	40 inches FFD (Fig. 87A).
mobilization:	Sandbag under opposite shoulder.
otective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
structions to Patient:	"Please do not move."
planations:	AP: Anterior-posterior ID: Identification marker FFD: Focal-film distance Bucky tray: see Glossary
riations:	Patient standing or sitting upright. Tube 10° caudad, toward the patient's feet, central ray directed to center of cassette.

Figure 88. Scapula: Anterior-Posterior





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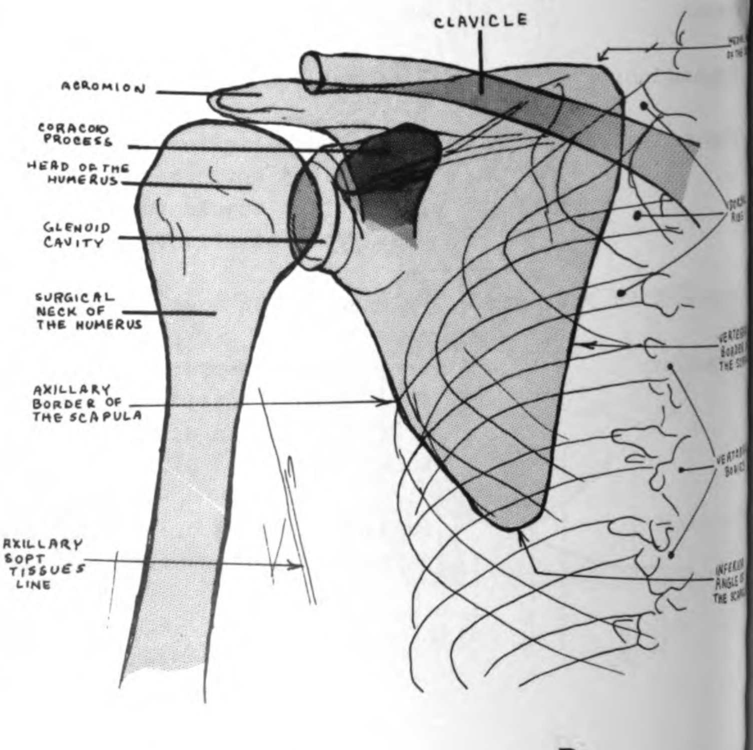

CLAVICLE
ACROMION
CORACOID PROCESS
HEAD OF THE HUMERUS
GLENOID CAVITY
SURGICAL NECK OF THE HUMERUS
AXILLARY BORDER OF THE SCAPULA
AXILLARY SOPT TISSUES LINE

D

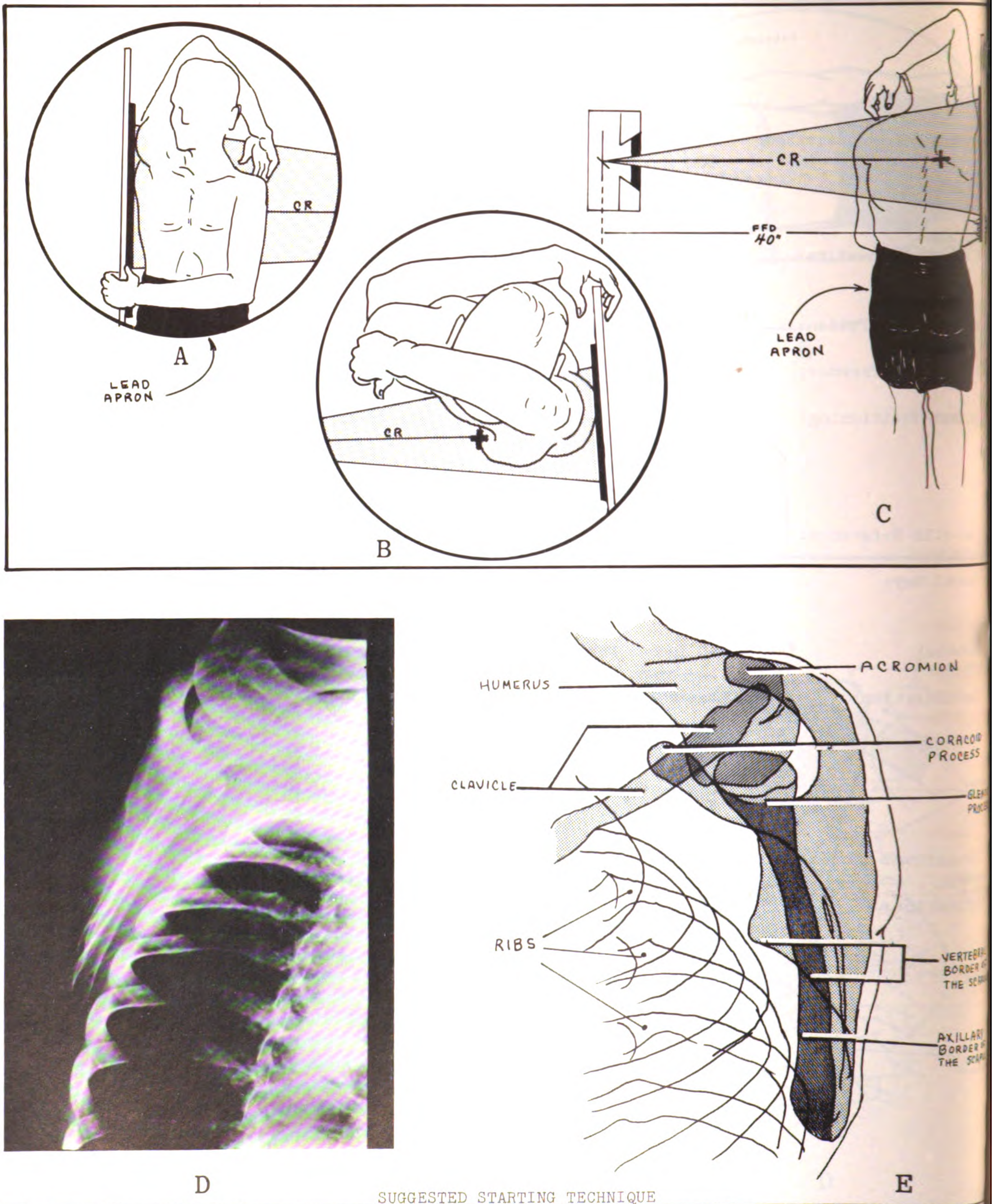
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM S
AP SCAPULA	13-17	100	1	80-90	100	40"	YES	NO	YES	0°	10" x

SCAPULA: ANTERIOR-POSTERIOR

tructures Demonstrated:	Scapula with articulations, proximal portion of the humerus (Fig. 88C and D).
ilm Size:	10" x 12", lengthwise, in Bucky tray (Fig. 88B).
ilm Identification:	ID marker on upper border, above proximal humerus; right or left marker on right or left border of cassette.
atient Preparation:	All obstructive clothing removed.
easuring Reference:	AP thickness of upper chest (Fig. 88B).
atient Positioning:	Patient in supine position on X-ray table. Affected shoulder centered over mid-line of table. Affected arm abducted until upper arm at right angles to mid-axillary line. Forearm at right angle with upper arm. Hand supine over sandbag. Opposite shoulder elevated (Fig. 88A).
art-Film Reference:	Posterior portion of body of scapula at center of cassette (Fig. 88B).
entral Ray:	Perpendicular through point 2" inferior and 1" medial to coracoid process, to center of cassette in Bucky tray (Fig. 88A).
istance:	40 inches FFD (Fig. 88A).
mmobilization:	Sandbag on supine hand; sandbag under opposite shoulder.
rotective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
nstructions to Patient:	"Please do not move."
xplanations:	AP: Anterior-posterior ID: Identification marker FFD: Focal-film distance Bucky tray: see Glossary

Figure 89. Scapula: Lateral



SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM S
LATERAL SCAPULA	18-22	100	1	75-85	100	40"	YES	NO	YES	90°	10" x

SCAPULA: LATERAL

tructures Demonstrated:	Body of scapula, acromion and head of humerus (Fig. 89D and E).
ilm Size:	10" x 12" cassette lengthwise in Bucky tray.
ilm Identification:	ID marker upper border above shoulder; right or left lateral marker on lateral border of cassette.
atient Preparation:	Obstructive clothing removed.
easuring Reference:	Plane between tip of acromion and vertebral border of scapula (Fig. 89C).
atient Positioning:	Patient upright in lateral position, affected shoulder against Bucky diaphragm or grid. Affected arm extended and flexed over head. Opposite arm brought over to grasp upright cassette support. Plane between tip of acromion process and vertebral border of scapula perpendicular to surface of Bucky and over center line (Fig. 89C).
art-Film Reference:	Affected shoulder against Bucky or grid forward of center of Bucky or grid (Fig. 89A).
entral Ray:	Horizontal, perpendicular to center of cassette (Fig. 89B).
istance:	40 inches FFD (Fig. 89C).
rotective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
nstructions to Patient:	"Please do not move."
xplanations:	ID: Identification marker FFD: Focal-film distance Bucky diaphragm, grid: see Glossary
ariation:	Compression band to hold patient, if patient is too weak to stand alone.

CHAPTER VII

OSTEOLOGY OF THE LOWER EXTREMITIES

OSTEOLOGY OF THE EXTREMITIES

LOWER EXTREMITY

The bones of the lower extremity (Figure 90) are divided into four groups:

1. The pelvic girdle, which is composed of the innominates (see Glossary) of the hip bones (two).
2. The thigh (between the hip and the knee), composed of the femur. Note: the patella (knee cap) is included here for convenience.
3. The leg, between the knee and ankle, composed of two parts:
   a. tibia (medial portion)
   b. fibula (lateral portion)
4. The foot, composed of three groups of bones:
   a. tarsus (seven tarsal bones)
   b. metatarsus, or foot proper (five metatarsal bones)
   c. digits or toes (fourteen phalanges).

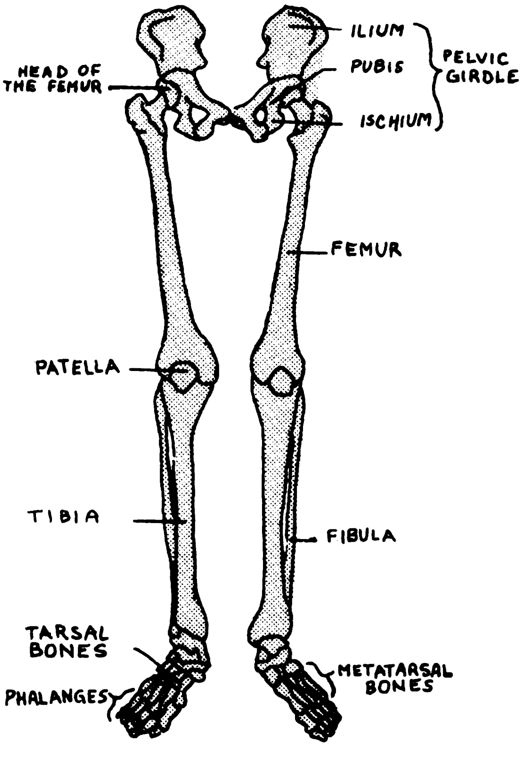


Figure 90.
Lower appendicular skeleton.

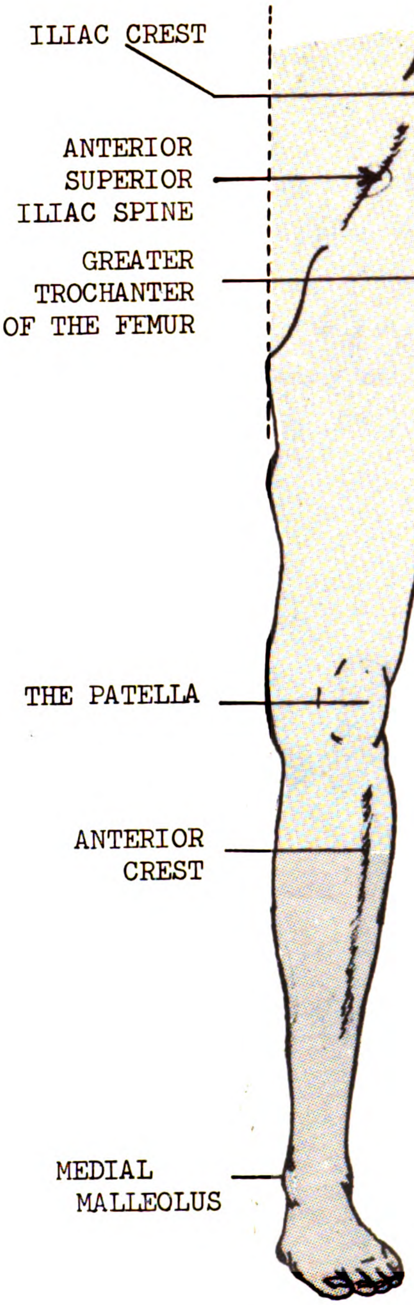

ILIAC CREST
ANTERIOR SUPERIOR ILIAC SPINE
GREATER TROCHANTER OF THE FEMUR
THE PATELLA
ANTERIOR CREST
MEDIAL MALLEOLUS

Figure 91A.
External aspect.

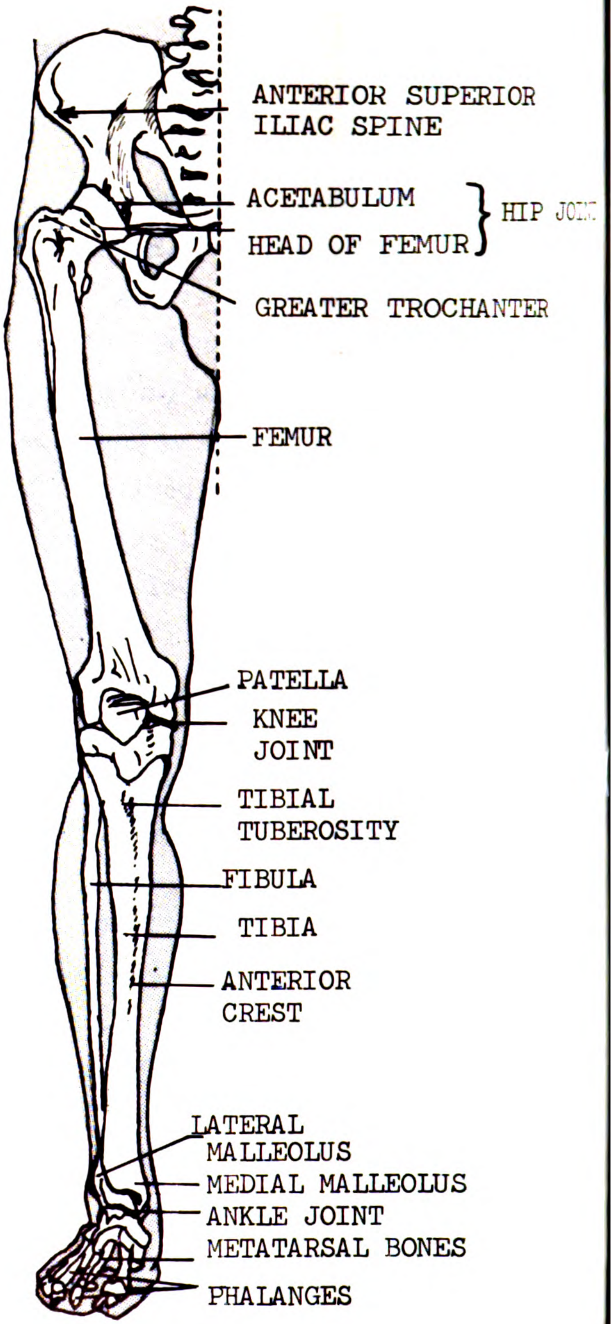


Figure 91B.
Skeletal aspect.

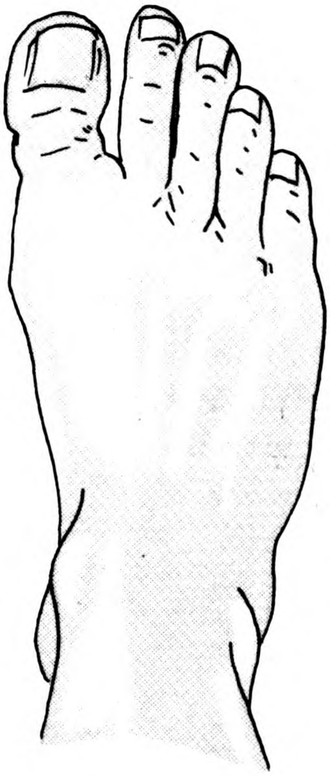
The bones of the foot are arranged and adapted to each other so that they form two distinct arches, the longitudinal arch and the transverse arch. These arches form a firm basis of support for the body in the standing position. They give elasticity to the step and they accommodate the plantar blood vessels, nerves, tendons, and muscles.

The longitudinal arch is the principal one, and can be seen when the foot is viewed from the medial or inner side.

The three cuneiform bones and the cuboid, with the proximal ends of the metatarsal bones, form the transverse arch.

The "top"of the foot is referred to as the dorsal aspect. The "bottom" of the foot is referred to as the plantar aspect.

Figure 92A.
Plantar topographical aspect.



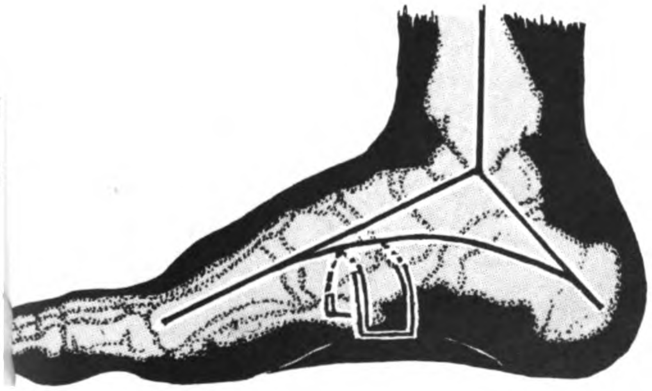


Figure 92C.
Lateral view, showing the arches.

Figure 92B.
Dorsal topographical aspect.

The twenty-six bones of the foot may be divided into three parts; the tarsus, the metatarsus, and the phalanges. There are seven tarsal bones arranged in a "U" shape starting with the calcaneous and ending with the talus. The tarsal bones are bound closely together by ligaments. See Figure 93A.

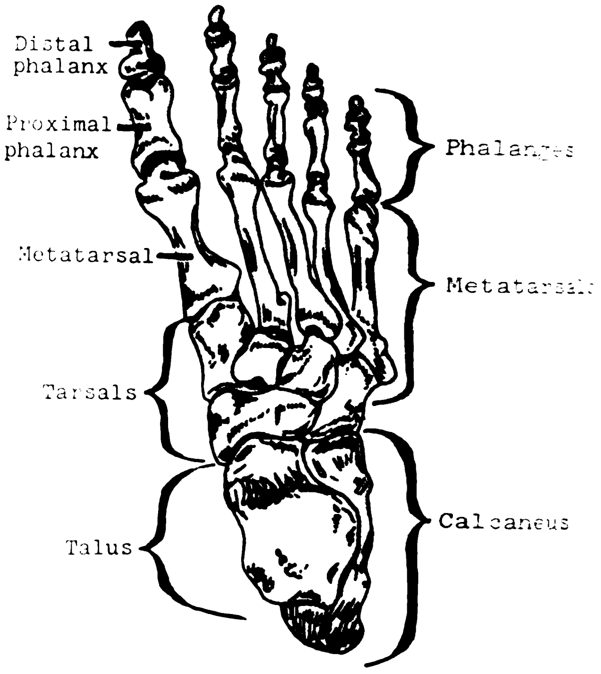


Figure 93A.
Superior aspect
of the right foot.

The tarsal bones articulate proximally with the tibia and fibula and distally with the metatarsal bones. See Figure 93B.

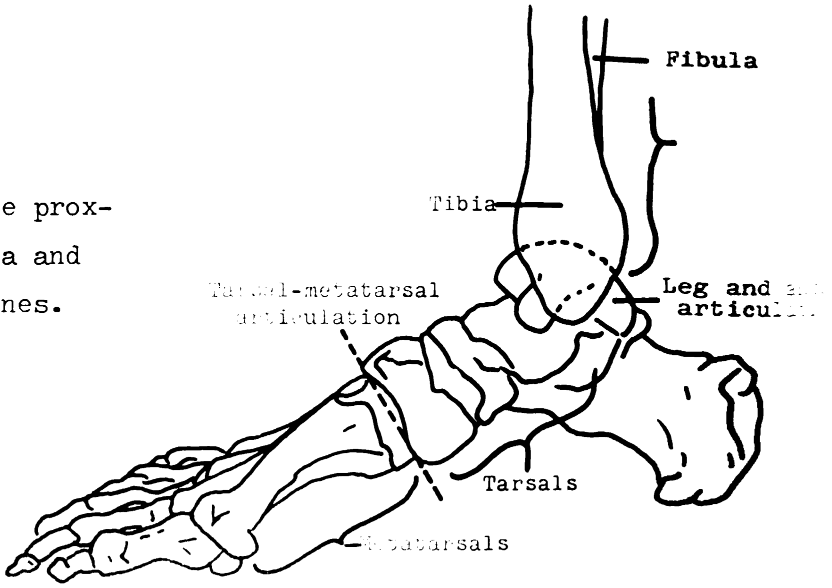


Figure 93B.
Right medial view,
tarsal-metatarsal articulation.

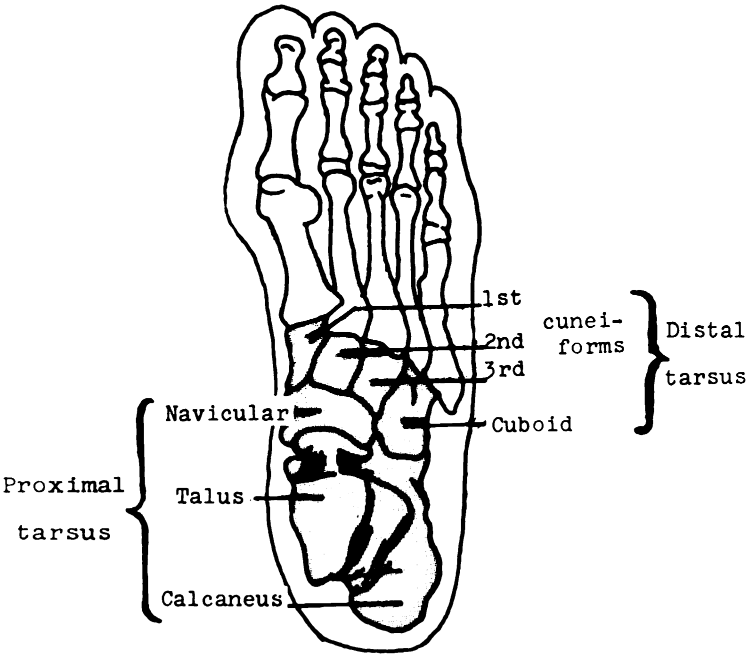


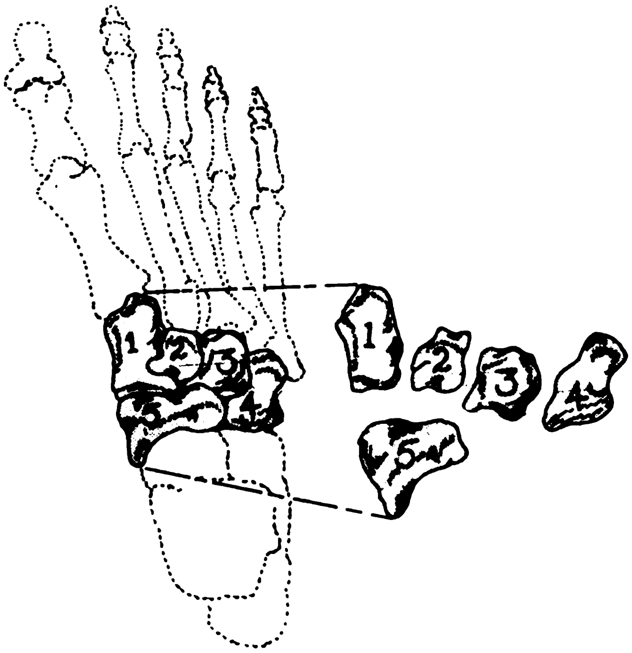
Figure 94A.
Right foot showing tarsus.

The tarsus contains seven bones, referred to collectively as the tarsal bones. The tarsal bones are divided into a proximal region consisting of

the calcaneus
the talus, and
the navicular.

See Figure 94A.

The distal row (named from medial to lateral) consists of the first, second and third cuneiform bones and the cuboid. See Figure 94B.



1. First cuneiform
2. Second cuneiform
3. Third cuneiform
4. Cuboid
5. Navicular

Figure 94B.
Cuneiforms, cuboid and navicular.

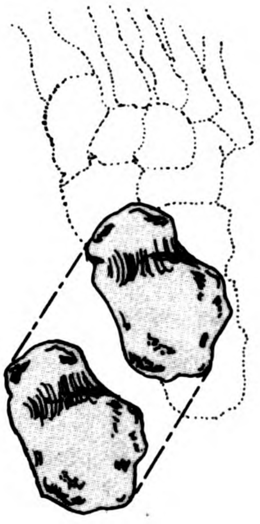


Figure 95A.
Talus.

The talus (astragalus) is the second largest of the tarsal bones. It consists of a body, a head, and a neck. See Figure 95A.

The calcaneus (os calcis) or heel bone is the largest of the tarsal bones. Its large posterior end forms the heel. See Figure 95B.

1) Anterior articular facet.
2) Middle articular facet.
3) Floor of sinus tarsi.
4) Posterior articular facet.
5) Tuberosity.
6) Sustentaculum tali.

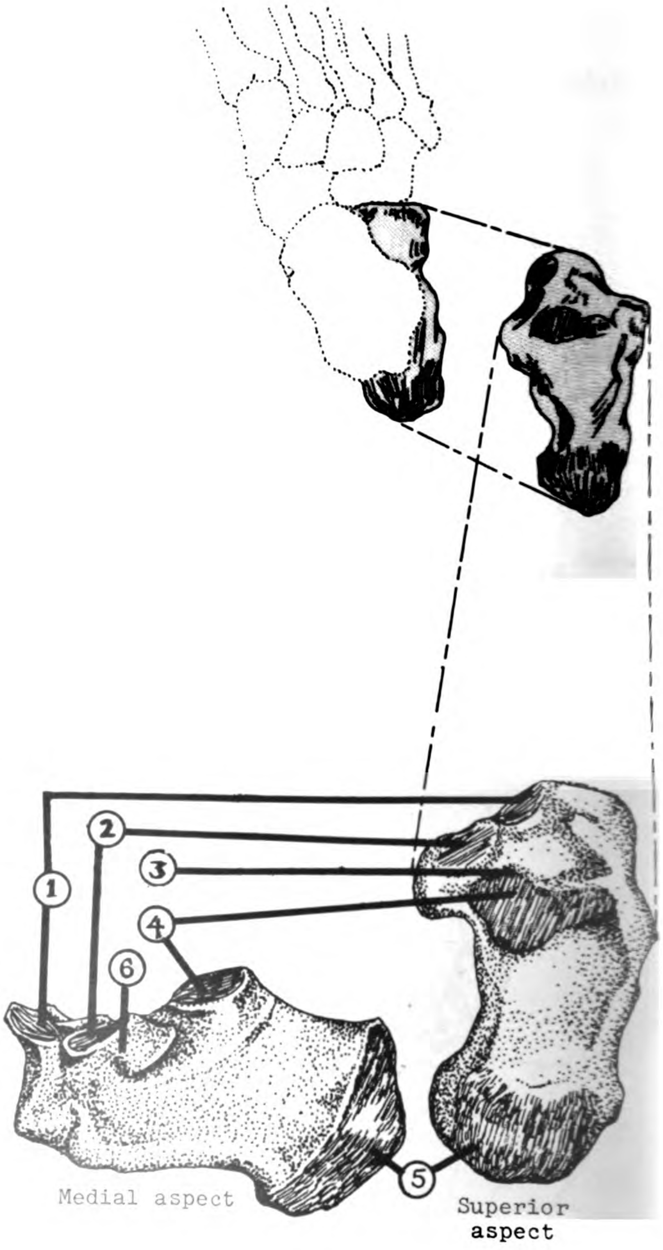


Figure 95B.
Calcaneus.

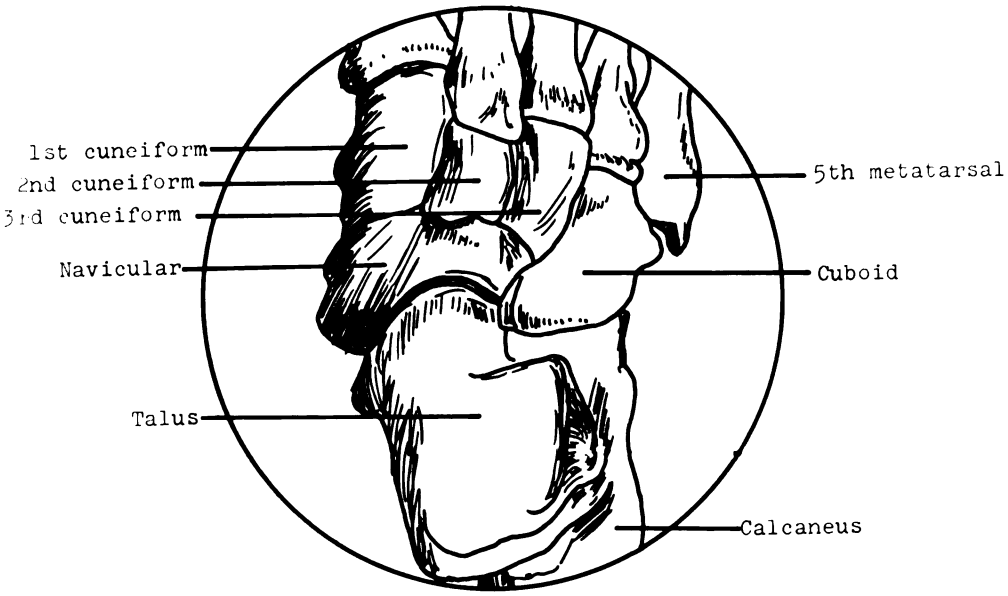


Figure 96A.
Right foot showing cuneiforms, navicular and cuboid.

The navicular (scaphoid) bone is somewhat boat-shaped. It is situated on the medial side of the foot between the talus posteriorly and the cuneiform bones anteriorly.

The cuboid is a cube-shaped bone. It is situated on the lateral side of the foot in front of the calcaneus and behind the fourth and fifth metatarsal bones.

The cuneiform bones are placed at the anterior portion of the tarsus, lying side-by-side between the navicular bone and bases of the first three metatarsals. See Figure 96A.

The foot proper is formed by the metatarsus. The metatarsal bones are numbered one through five, from the medial to the lateral side. Each of these bones has a proximal portion, a body, and a distal portion. The distal portion articulates with the phalanges. The proximal portion of these long bones articulates with the tarsus. See Figure 96B.

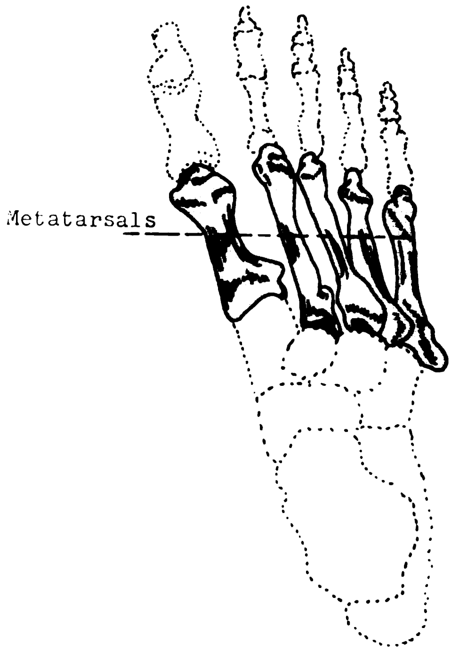


Figure 96B.
Right foot showing metatarsal bones.

The first metatarsal, which provides attachment to the great toe, is the shortest and strongest of the metatarsal bones. It serves as the main support of the body when in the walking position. The heads of the five metatarsal bones form the ball of the foot. See Figure 97A.

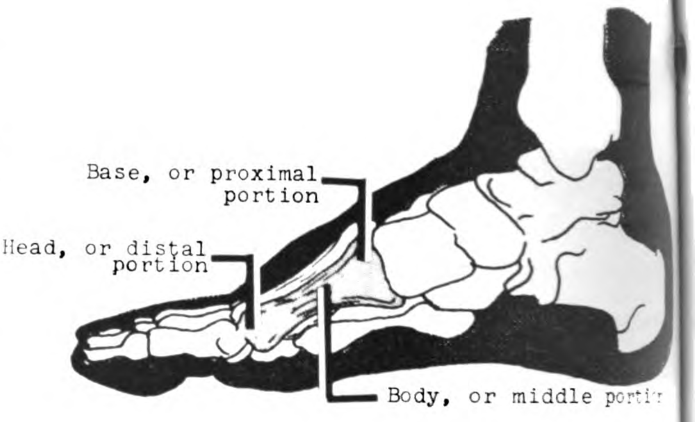


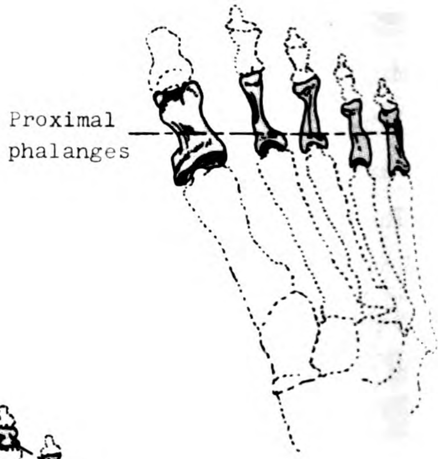
Figure 97A.
Right foot, medio-lateral
showing first metatarsal.

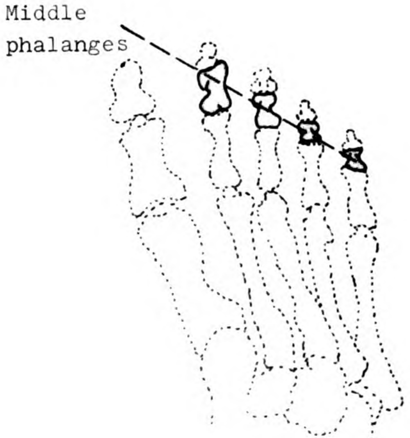
The digits, or toes, contain fourteen phalanges. The great toe contains two phalanges. The other toes contain three phalanges:

the proximal,
the middle, and
the distal.

Each phalanx has a shaft and two extremities.

The distal end of each distal phalanx is flat and expanded for the support of the toe nail. See Figure 97B.





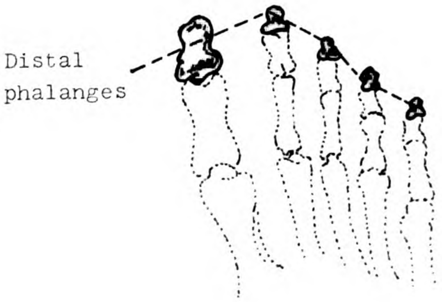


Figure 97B. Right foot showing phalanges.

Leg (Tibia and Fibula)

The word leg is reserved for that portion of the lower extremity which lies between the knee and the ankle. The leg has two bones, the tibia and the fibula, which are parallel, or side-by-side.

The tibia (shin bone) is situated in the medial portion of the leg. It is the larger of the two bones and transmits the weight of the body from the femur to the foot. It has a superior (upper) extremity, a shaft, and an inferior (lower) extremity. At the upper extremity are two concave areas that articulate with the condyles of the femur.

Situated on the distal extremity is a process called the medial malleolus, which forms the prominence on the medial side of

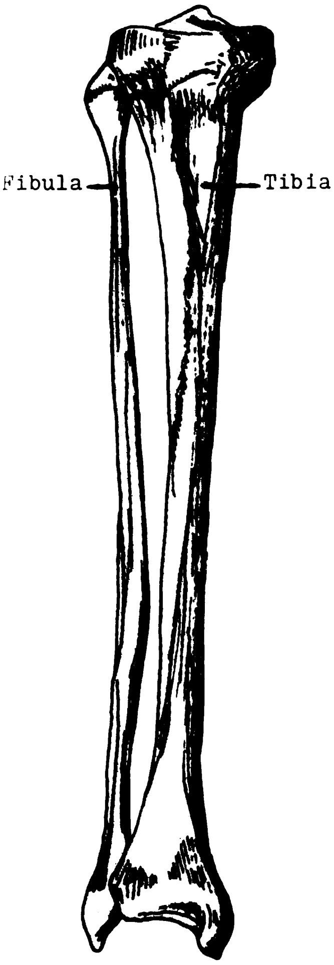


Figure 98A.
Anterior aspect,
medial portion of leg.

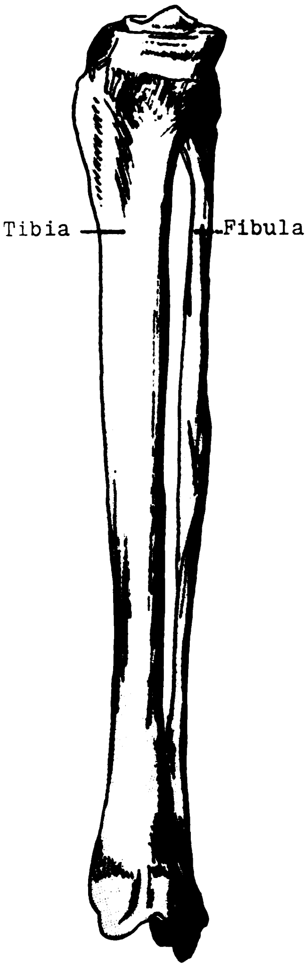


Figure 98B.
Medio-lateral aspect,
medial portion of leg.

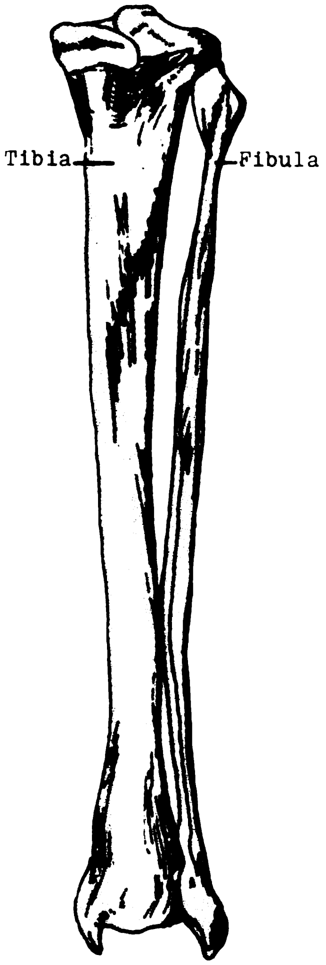


Figure 98C.
Posterior aspect,
medial portion of leg.

the ankle. On the lower extremity of the tibia are the surfaces for the articulation with the tarsus. The bony support for the medial surface is the internal malleolus.

The fibula is a long, thin bone situated on the lateral side of the leg. It articulates with the tibia at its superior and inferior extremities. Although approximately the same length as the tibia, it does extend below the inferior extremity of the tibia. The prominence of the lateral side of the ankle is the lateral malleolus. The fibula does not articulate with the femur or patella and does not help to form the knee joint. The proximal fibula articulates with the tibia.

Femur. The femur is the only bone in the thigh and is also the largest bone in the skeleton. Extending from the hip joint to the knee joint, it transmits the weight of the body from the pelvis to the tibia. It may be divided into three parts: the superior extremity, composed of the head, neck and trochanters; the shaft; and the inferior extremity composed of the condyles and the epicondyles.

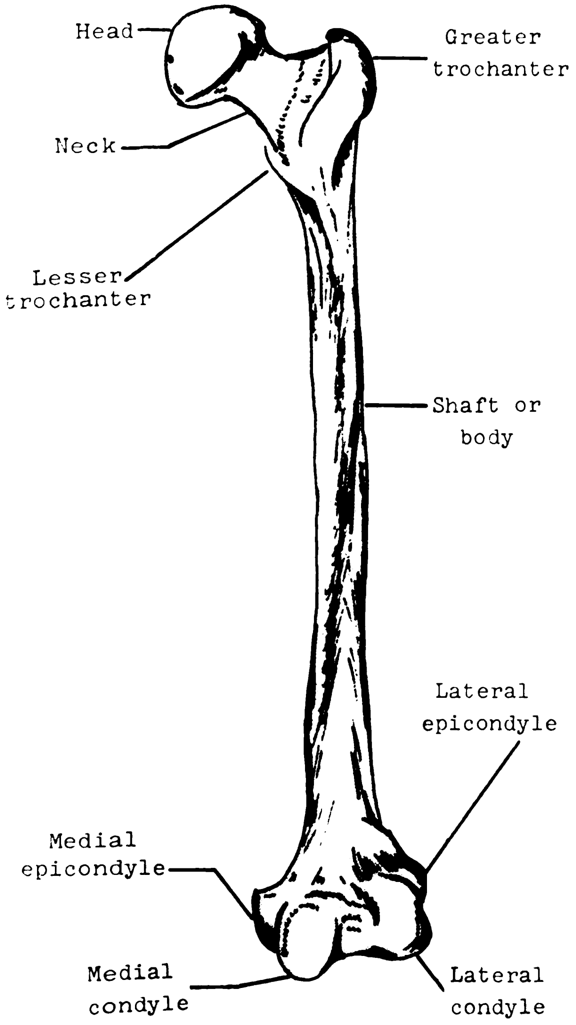


Figure 99B.
Right femur, posterior aspect.

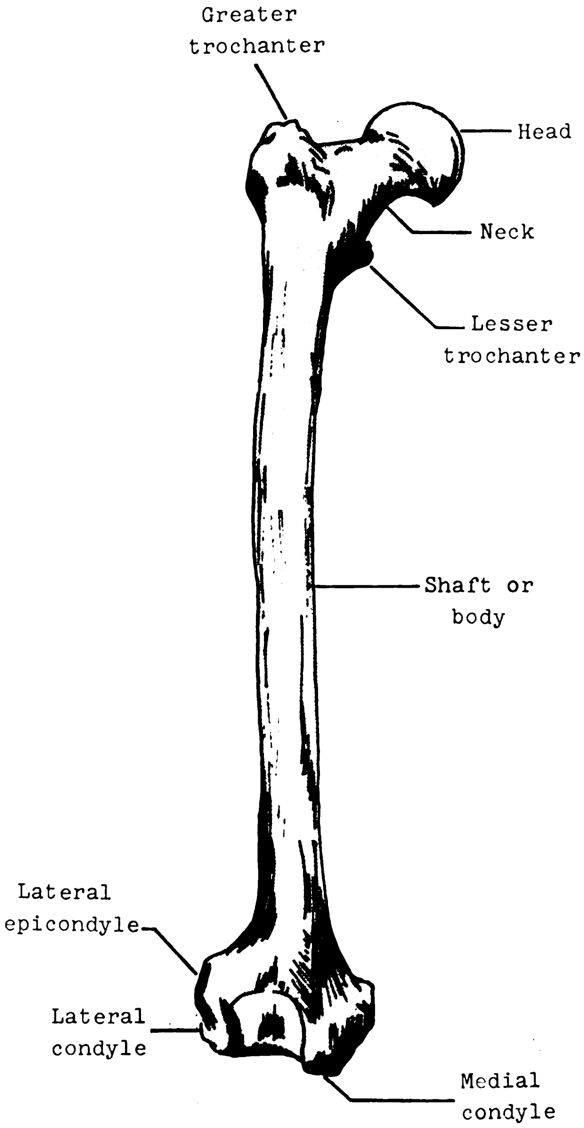
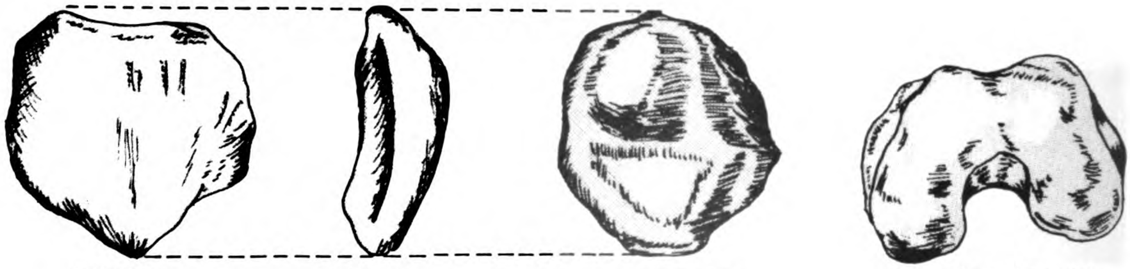


Figure 99A.
Right femur, anterior aspect.

The head of the femur fits into the acetabulum, forming a ball-and-socket joint. There are two prominent processes of the bone at the junction of the neck and the shaft of the femur. The upper process is called the greater trochanter and the lower and smaller process is called the lesser trochanter. The greater trochanter can be felt through the skin.

The inferior extremity of the shaft becomes wider and thicker and forms the medial and lateral condyles. These condyles articulate with the upper extremity of the tibia. The trochlea is a rounded prominence in which the patella glides. It extends upward and anteriorly from the lateral condyle. Above the condyles on either side of the bones are the epicondyles.

Patella. The patella (knee cap) is a sesamoid bone developed in the extensor tendon of the knee, and is situated on the front of the knee joint. It is somewhat triangular in shape with its pointed apex directed inferiorly and its broad base superiorly. The anterior (front) surface is rough; the posterior, or articulating surface is smooth.



Anterior Aspect

Lateral Aspect

Posterior Aspect

Inferior Aspect

Figure 100.
Right patella.

The Pelvic Girdle or Pelvis

The pelvic girdle or pelvis is a complete bony girdle made up of the innominate bones laterally and in front, and the sacrum and coccyx behind. Anteriorly, the two innominate bones are joined at the symphysis pubis. Posteriorly, the iliac portions of the innominate bones are joined to the sacrum at the sacro-iliac joints.

The innominate bones. The innominate bones consist of three parts: the ilium, the ischium and the pubis. In a young person these are three separate, distinct bones. They are fused and consolidated in the adult. The bodies of these three portions meet and unite in and around a large, cup-shaped socket, the acetabulum, which is situated near the middle of the lateral surface of the bone. The ilium is the upper expanded portion of the bone, and its body forms the upper two-fifths of the acetabulum. The ischium forms the lower and back part of the bone. Its body also contributes about two-fifths to the acetabulum. The pubis forms the anterior and inferior portion of the bone. Its body contributes one-fifth to the acetabulum.

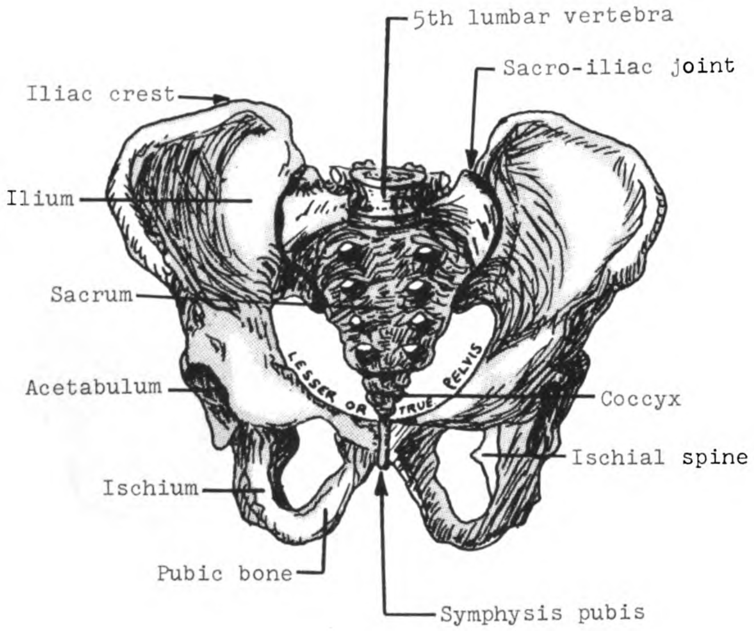


Figure 101.
Pelvis, anterior view.

The ilium is divided into a body and a flared portion called the wing. The upper border of the wing is called the iliac crest. The crest terminates anteriorly as the anterior-superior iliac spine. The crest of the ilium terminates posteriorly as the posterior-superior iliac spine.

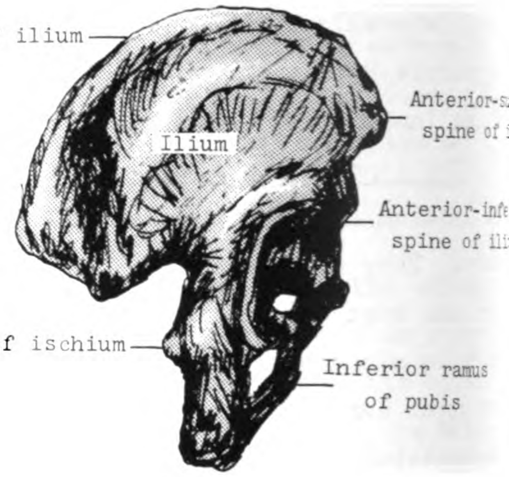


Figure 102A.
Right hip bone, external surface.

The ischium is composed of a centrally located body, a superior ramus, and an inferior ramus. The ischial spine projects posteriorly from the body. The superior ramus branches downward from the body. The ischial tuberosity is situated on the posterior aspect of the superior ramus. The inferior ramus ascends from the superior ramus and joins the inferior ramus of the pubis.

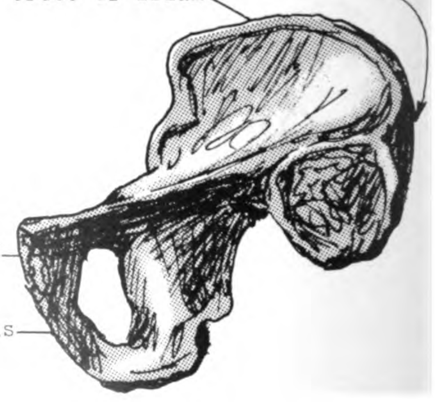


Figure 102B.
Right hip bone, internal surface.

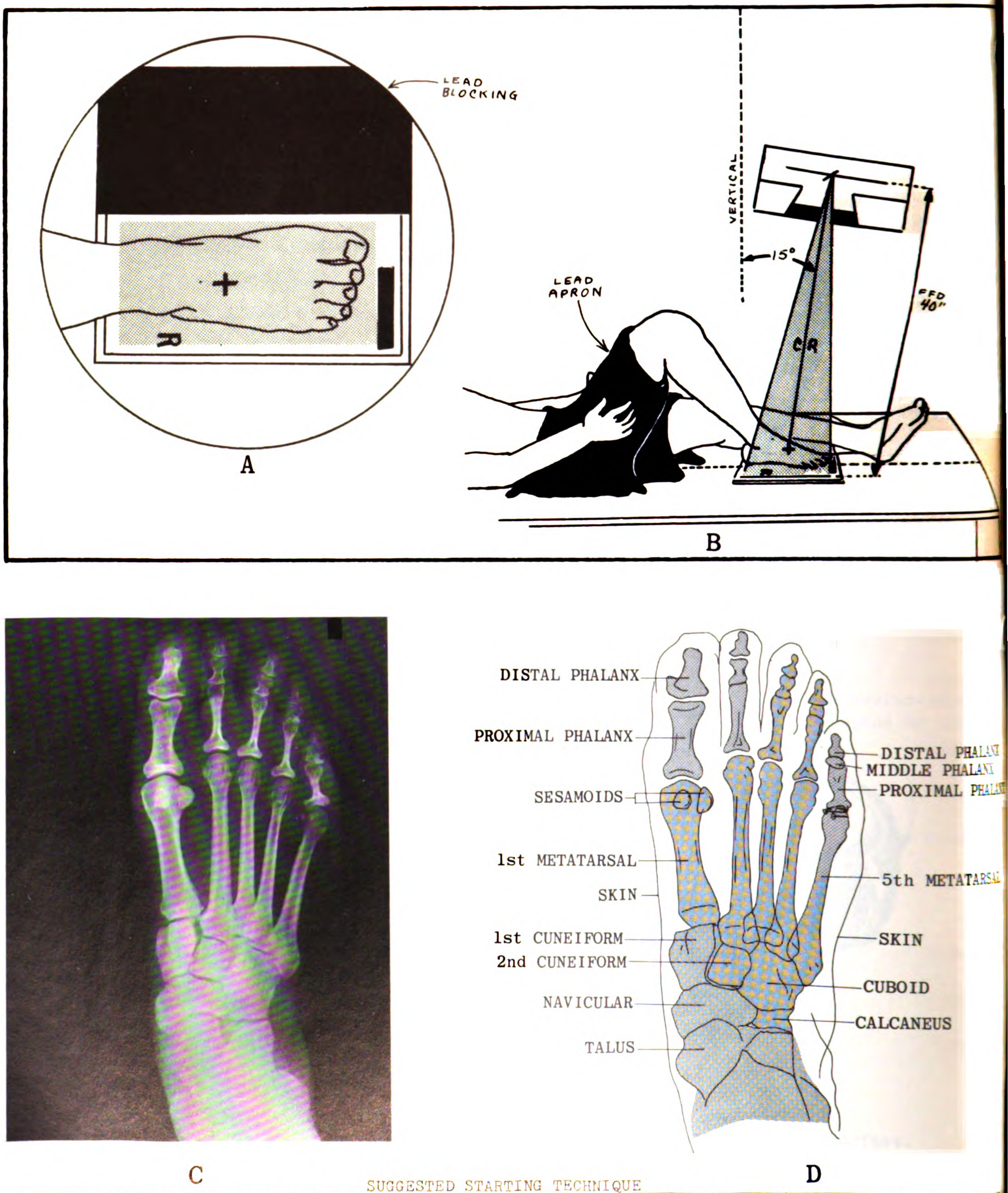
The pubis is divided in a centrally located body, a superior ramus and an inferior ramus.

CHAPTER VIII

THE RADIOGRAPHIC EXAMINATION

LOWER EXTREMITIES

Figure 103. Foot: Anterior-Posterior (Dorsoplantar)



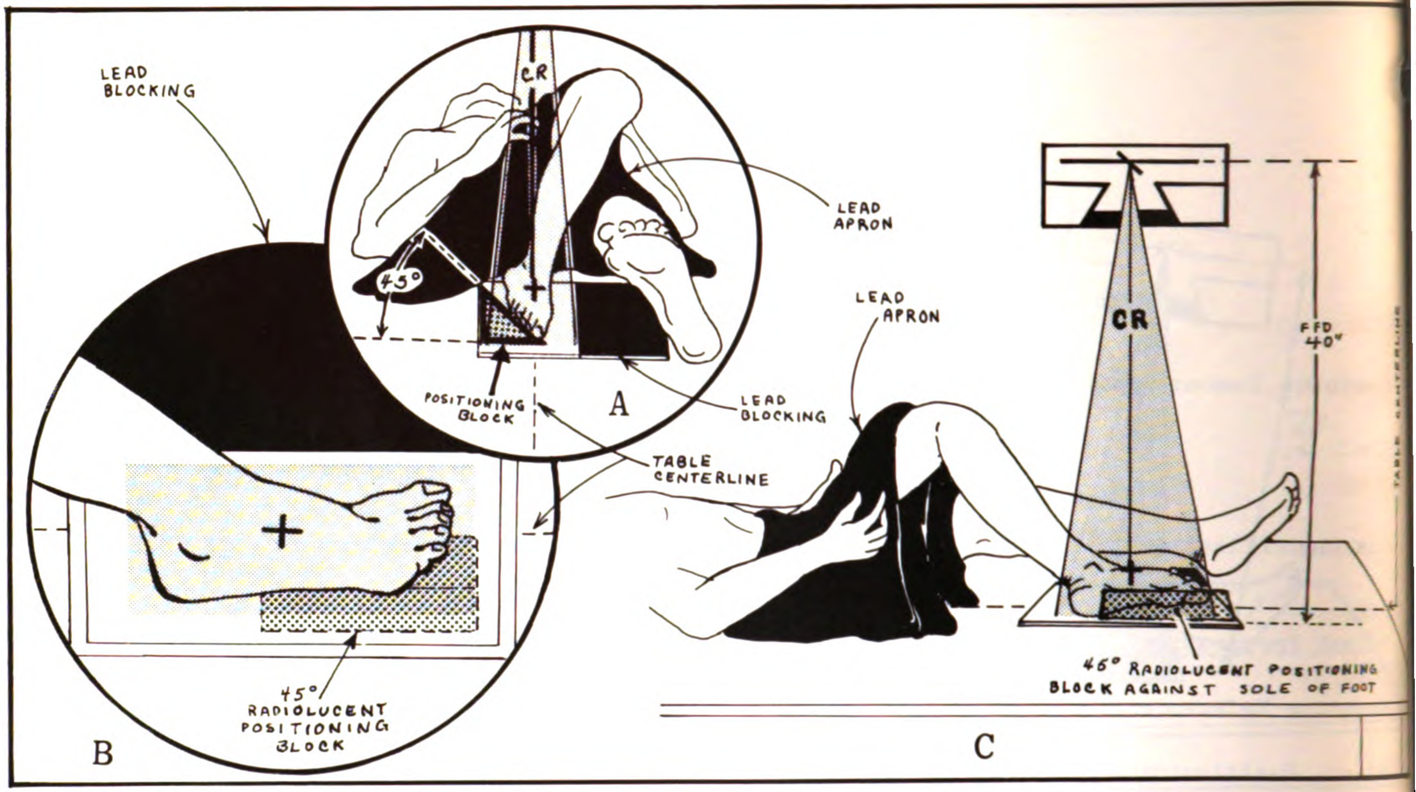
SUGGESTED STARTING TECHNIQUE

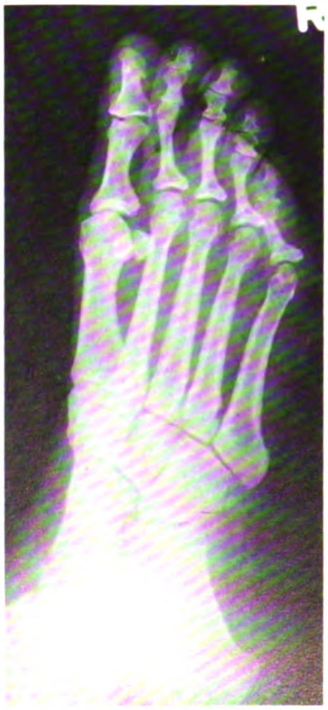
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
AP	5-8	100	1/10	50-60	10	40"	YES	NO	NO	15°	10" x 12"
FOOT	5-8	100	1	60-70	100	40"	NO	YES	NO	15°	10" x 12"

FOOT: ANTERIOR-POSTERIOR
(DORSOPLANTAR)

tructures Demonstrated:	Phalanges, metatarsal bones and tarsal bones (Fig. 103C and D).
ilm Size:	10" x 12" crosswise, one-half covered with lead blocker for two views on one film (Fig. 103A).
ilm Identification:	ID marker above the toes, right or left marker on border of film (Fig. 103A).
Patient Preparation:	Shoe and stocking removed.
Measuring Reference:	Mid-metatarsal bones (Fig. 103A).
Patient Positioning:	Patient supine on X-ray table, or supine with knee flexed. Foot on film holder with great toe two inches from upper border of film holder (Fig. 103B).
Part-Film Reference:	Plantar portion of foot to center of film (Fig. 103A).
Central Ray:	15° toward heel, through mid-tarsal bones to center of film (Fig. 103B).
Distance:	40 inches FFD (Fig. 103B).
Immobilization:	Patient can support upper thigh with hands (Fig. 103B).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	AP: Anterior-posterior ID: Identification marker CR: Central ray FFD: Focal-film distance

Figure 104. Foot: Oblique





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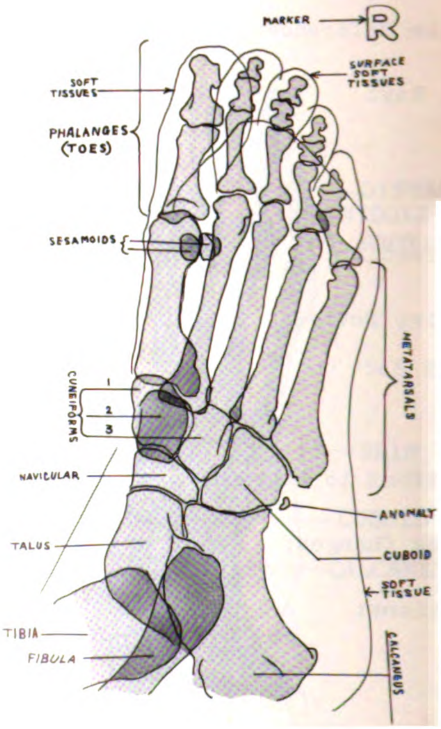


E

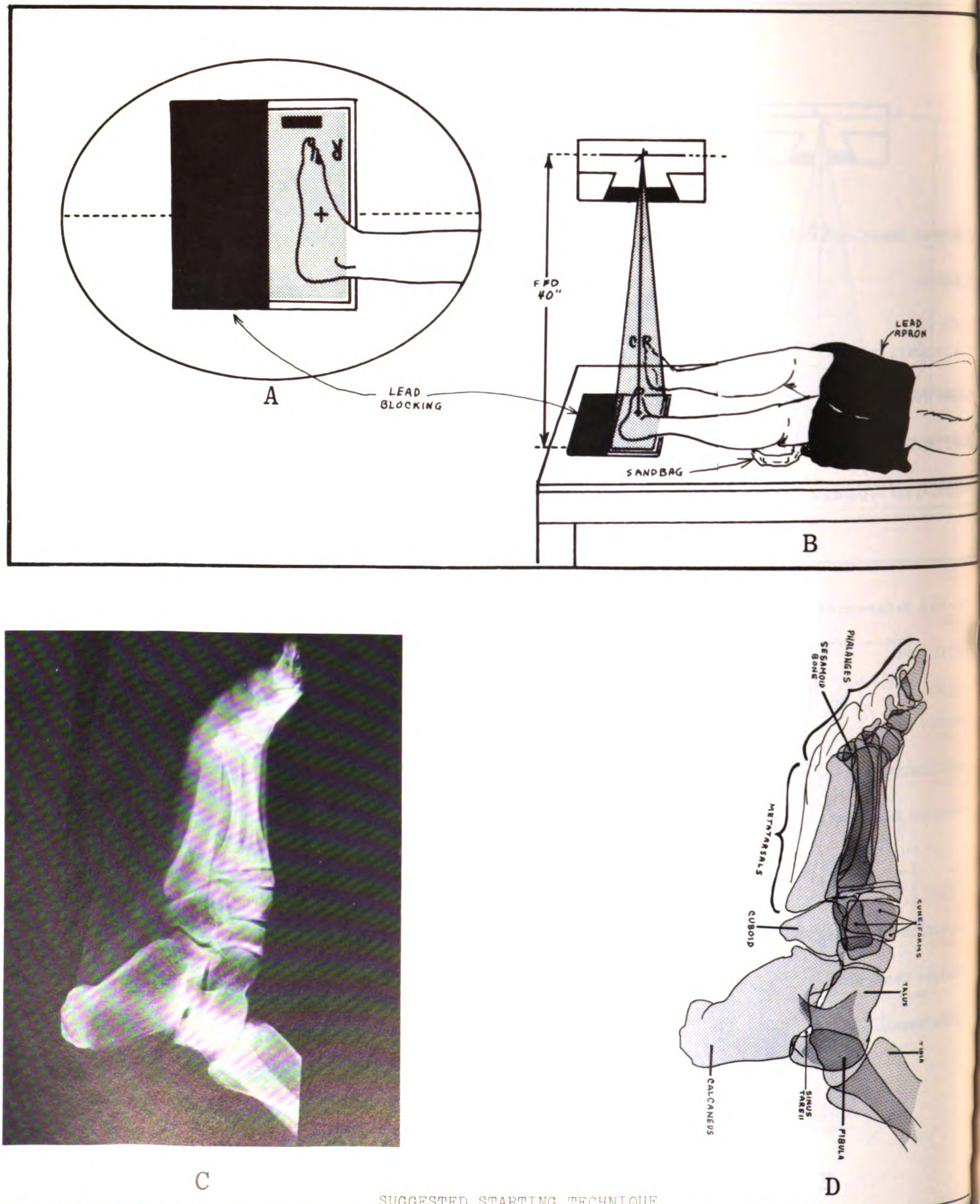
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZ
OBLIQUE	5-8	100	1/10	50-60	10	40"	YES	NO	NO	0°	10" x 12"
FOOT	5-8	100	1	60-70	100	40"	NO	YES	NO	0°	10" x 12"

FOOT: OBLIQUE

tructures Demonstrated:	Phalanges, metatarsal and tarsal bones (Fig. 104D and E).
ilm Size:	10" x 12" crosswise, one-half covered with lead blocker for two views on one film (Fig. 104A).
ilm Identification:	ID marker above the toes, right or left marker on border of film.
atient Preparation:	Shoe and stocking removed.
easuring Reference:	Mid-metatarsal (Fig. 104A).
atient Positioning:	Patient seated on X-ray table, or supine if unable to sit. Leg flexed, foot placed on film holder with great toe two inches from upper border. Knee rotated inward until plantar surface of the foot is at 45° angle with surface of film-holder (Fig. 104C). Use 45° radiolucent block.
art-Film Reference:	Medial plantar surface of foot on film.
entral Ray:	Perpendicular, through metatarsal bones, to center of film (Fig. 104B and C).
istance:	40 inches FFD (Fig. 104C).
Immobilization:	Opposite knee used to support angle of leg (Fig. 104C).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	ID: Identification marker CR: Central ray FFD: Focal-film distance

Figure 105. Foot: Lateral



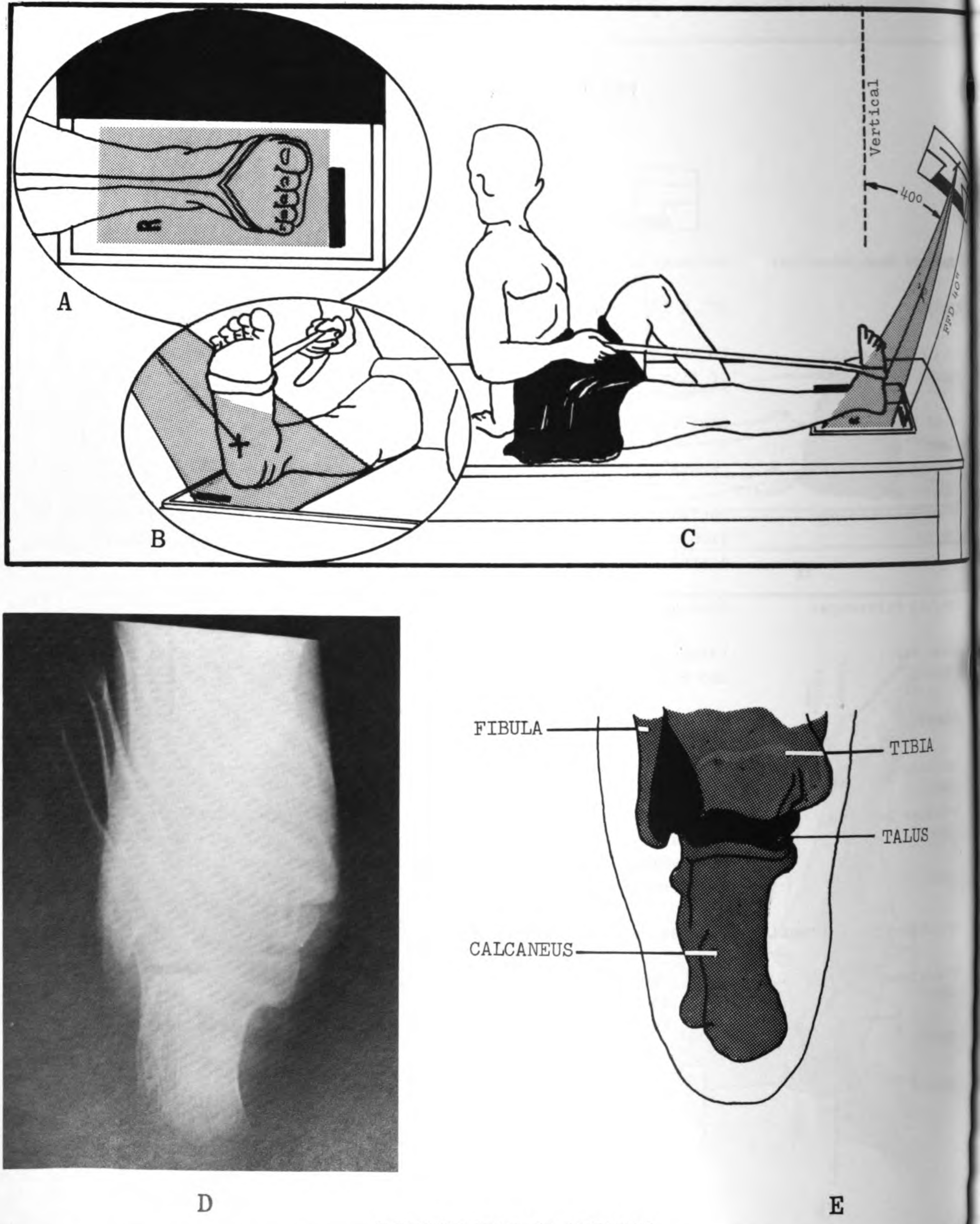
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
LATERAL	6-9	100	1/10	50-60	10	40"	YES	NO	NO	0°	10" x 1
FOOT	6-9	100	1	60-70	100	40"	NO	YES	NO	0°	10" x 1

FOOT: LATERAL

tructures Demonstrated:	Phalanges, metatarsal and tarsal bones (Fig. 105C and D).
ilm Size:	10" x 12" lengthwise (Fig. 105A).
ilm Identification:	ID marker above the toes (Fig. 105A); right or left marker on border of film.
atient Preparation:	Shoe and stocking removed.
easuring Reference:	Lateral portion of foot to film (Fig. 105A).
atient Positioning:	Patient lies on affected side on X-ray table. Lateral malleolus of fibula is closest to film-holder (Fig. 105B). Caution: include distal tibia and fibula.
art-Film Reference:	Lateral malleolus touching center of film (Fig. 105A).
entral Ray:	Perpendicular, to head of metatarsal, to center of film (Fig. 105A and B).
Distance:	40 inches FFD (Fig. 105B).
Immobilization:	Support under knee to keep foot in true lateral position.
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 106. Calcaneus (Os Calcis): Inferior-Superior



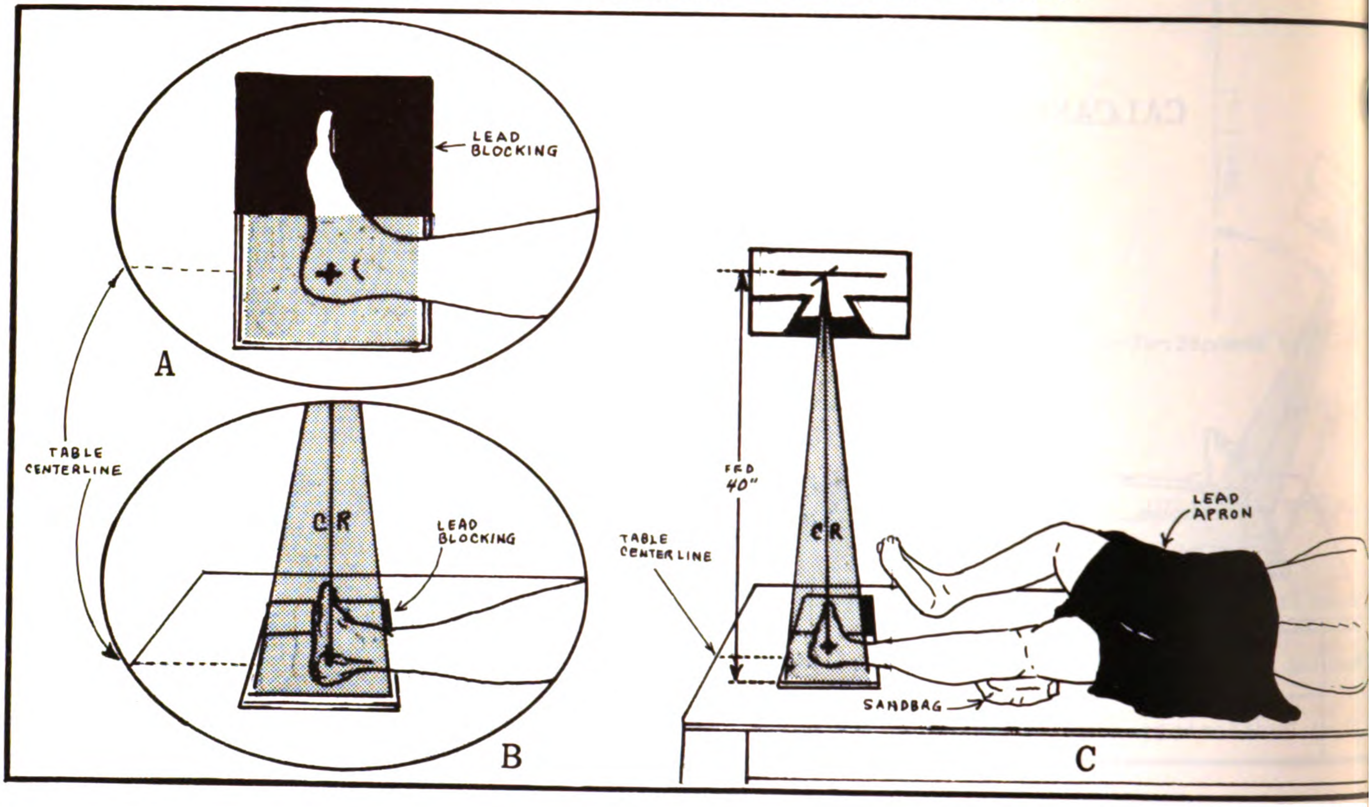
SUGGESTED STARTING TECHNIQUE

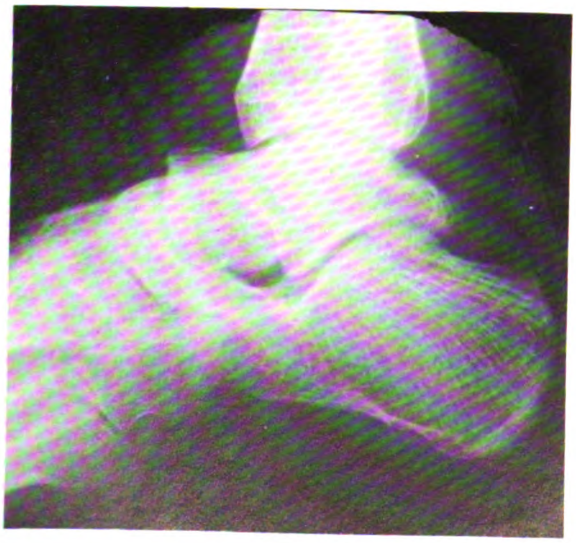
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
OS CALCIS	8-13	100	1/10	55-65	10	40"	YES	NO	NO	40°	8" x 10"
(TANGENTIAL)	8-13	100	1	60-70	100	40"	NO	YES	NO	40°	8" x 10"

CALCANEUS (OS CALCIS): INFERIOR-SUPERIOR

tructures Demonstrated:	Calcaneus (os calcis) (Fig. 106D and E).
ilm Size:	8" x 10" crosswise, one-half covered with a lead blocker for two views on one film (Fig. 106A).
ilm Identification:	ID marker below the calcaneus, right or left marker on border of film (Fig. 106A and B).
atient Preparation:	Shoe and stocking removed (Fig. 106A).
easuring Reference:	Calcaneus and medial malleolus (Fig. 106B).
atient Positioning:	Patient seated on X-ray table, Leg fully extended. Posterior aspect of heel of affected foot placed on film-holder. With a towel or a long piece or gauze wrapped around the distal metatarsal portion of foot, plantar surface of the foot drawn back until perpendicular to surface of film-holder (Fig. 106C).
art-Film Reference:	Posterior surface of the calcaneus at center of film (Fig. 106A).
entral Ray:	40° cephalad, passing through plantar surface of foot to center of film (Fig. 106C).
istance:	40 inches FFD (Fig. 106C).
mmobilization:	Gauze or towel held by patient (Fig. 106C).
rotective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
nstructions to Patient:	"Please do not move."
echnique Changes:	Dry or wet cast: see Glossary.
xplanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 107. Calcaneus (Os Calcis): **Lateral**





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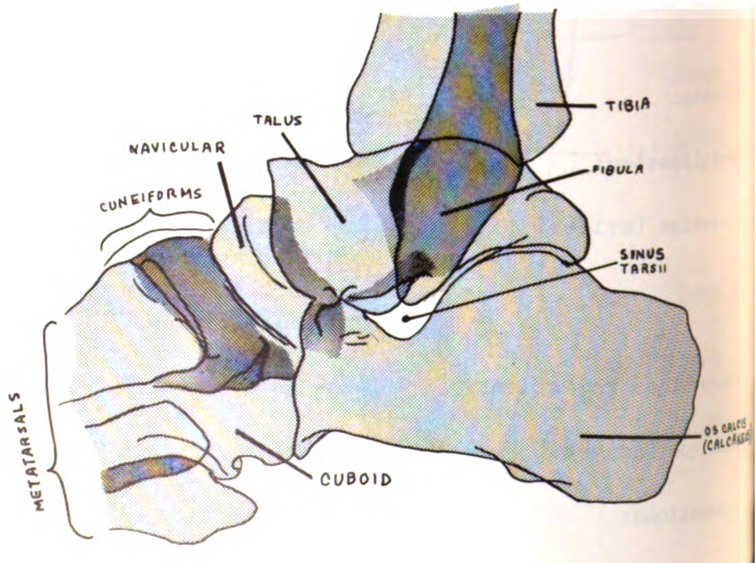


E

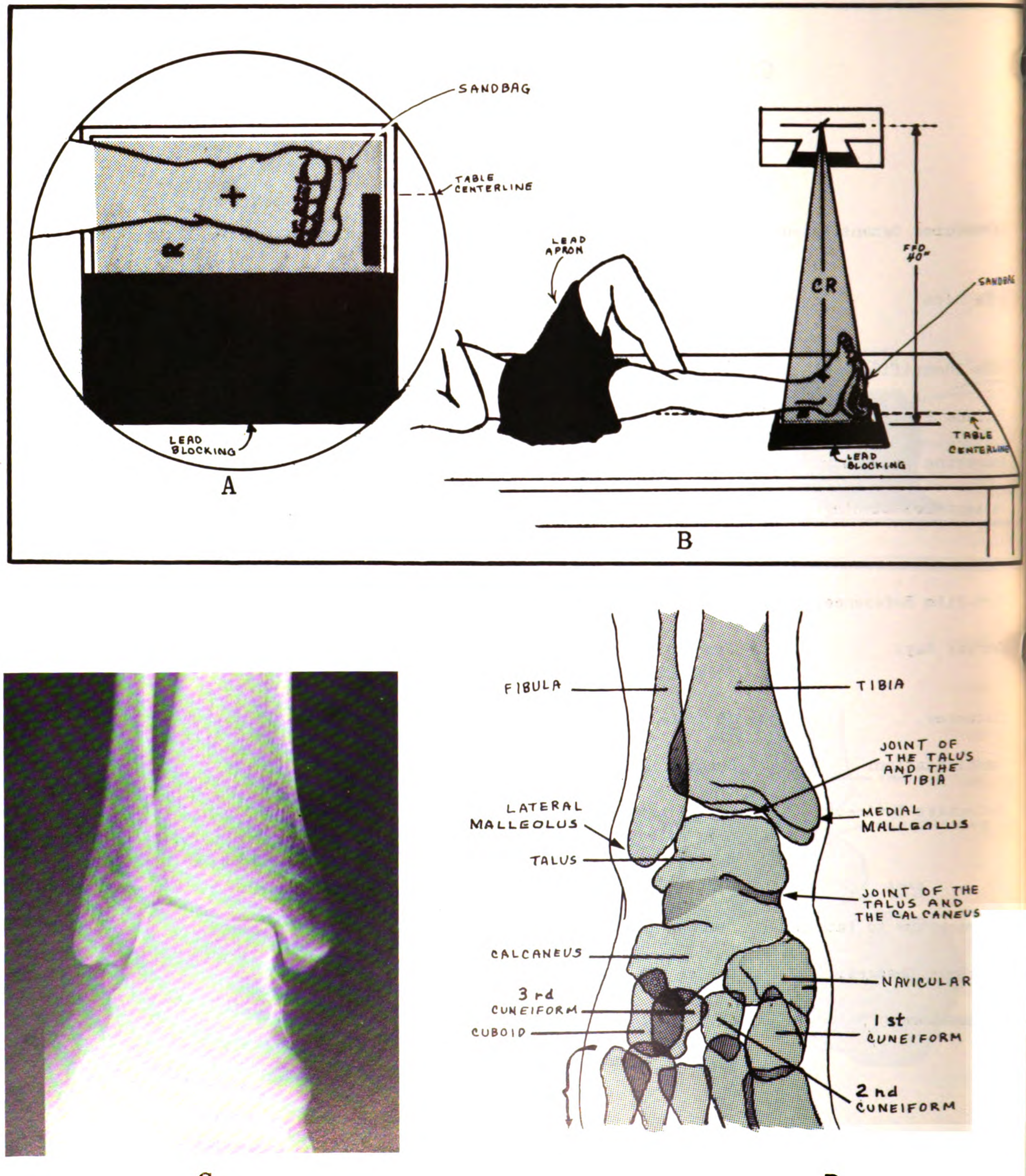
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
OS CALCIS	5-8	100	1/10	50-60	10	40"	YES	NO	NO	0°	8" x 10"
LATERAL	5-8	100	1	60-70	100	40"	NO	YES	NO	0°	8" x 10"

CALCANEUS (OS CALCIS): LATERAL

Structures Demonstrated:	Calcaneus (os calcis) with lateral and medial malleoli demonstrated (Fig. 107D and E).
Film Size:	8" x 10" crosswise, one-half covered with lead blocker for two views on one film (Fig. 107A).
Film Identification:	ID marker below the calcaneus, right or left marker on border of film.
Patient Preparation:	Shoe and stocking removed.
Measuring Reference:	Calcaneus (Fig. 107A).
Patient Positioning:	Patient in lateral recumbent position on X-ray table. Lateral aspect of affected calcaneus, ankle joint and proximal metatarsals on film-holder (Fig. 107C).
Part-Film Reference:	Calcaneus (os calcis) at unexposed center of film (Fig. 107A).
Central Ray:	Perpendicular to a point 2 inches inferior to malleolus, to center of film (Fig. 107B).
Distance:	40 inches FFD (Fig. 107C).
Immobilization:	Sandbag under foot.
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 108. Ankle: Anterior-Posterior



C

D

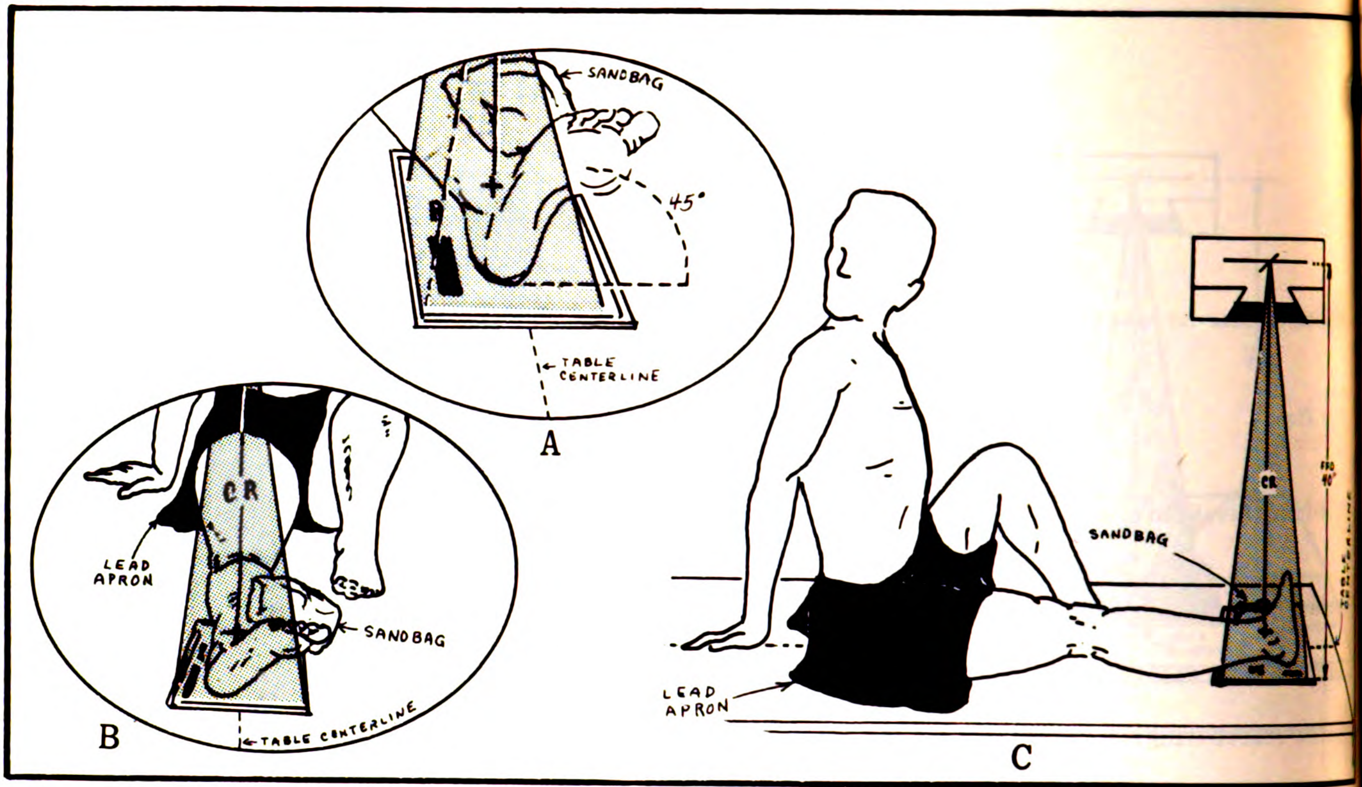
SUGGESTED STARTING TECHNIQUE

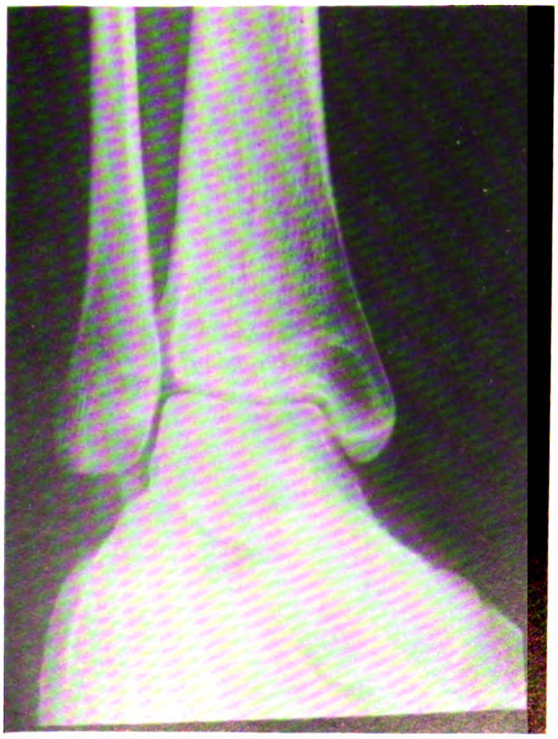
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
AP	8-11	100	1/10	60-70	10	40"	YES	NO	NO	0°	10" x 12"
ANKLE	8-11	100	1	65-75	100	40"	NO	YES	NO	0°	10" x 12"

ANKLE: ANTERIOR-POSTERIOR

tructures Demonstrated:	Medial and lateral malleoli and distal ends of tibia and fibula (Fig. 108C and D).
ilm Size:	10" x 12" crosswise, one-half covered with a lead blocker for two views on one film (Fig. 108A).
Film Identification:	ID marker above toes, right or left marker on border of film (Fig. 108A).
Patient Preparation:	Shoe and stocking and all obstructive clothing removed.
Measuring Reference:	Anterior-posterior ankle (malleolus) (Fig. 108A).
Patient Positioning:	Patient in supine position on X-ray table. Posterior aspect of ankle placed on film-holder. Ankle flexed until plantar surface of foot perpendicular to surface of film-holder. Foot and leg rotated until parallel to surface of film-holder (Fig. 108B).
Part-Film Reference:	Posterior ankle to center of film (Fig. 108A).
Central Ray:	Perpendicular, passing through midpoint of a line between the malleoli.
Distance:	40 inches FFD (Fig. 108B).
Immobilization:	A heavy sandbag angled against plantar surface of foot (Fig. 108B).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 109. Ankle: Oblique





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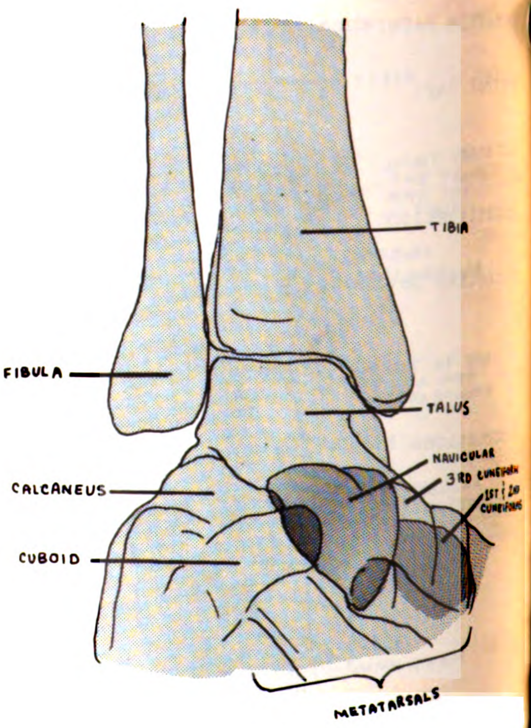


E

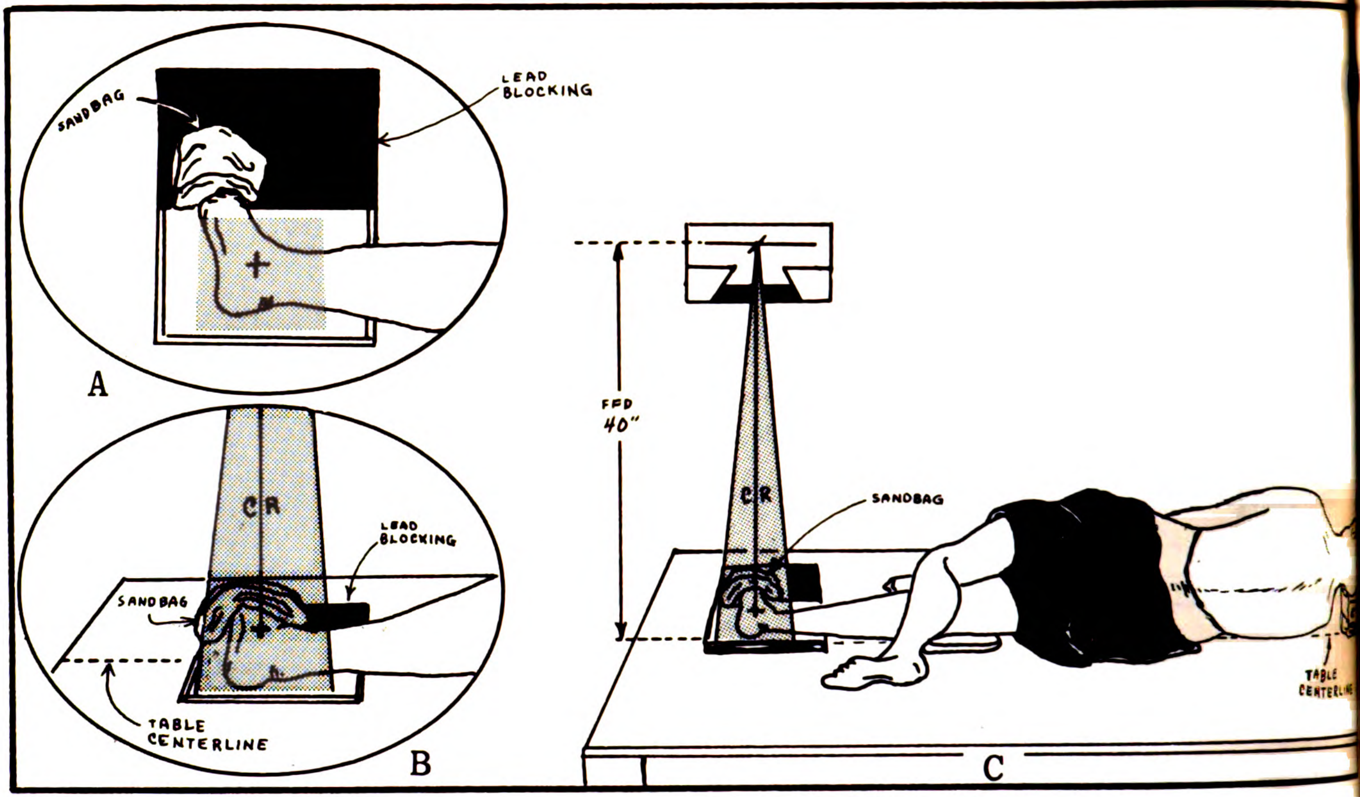
SUGGESTED STARTING TECHNIQUE

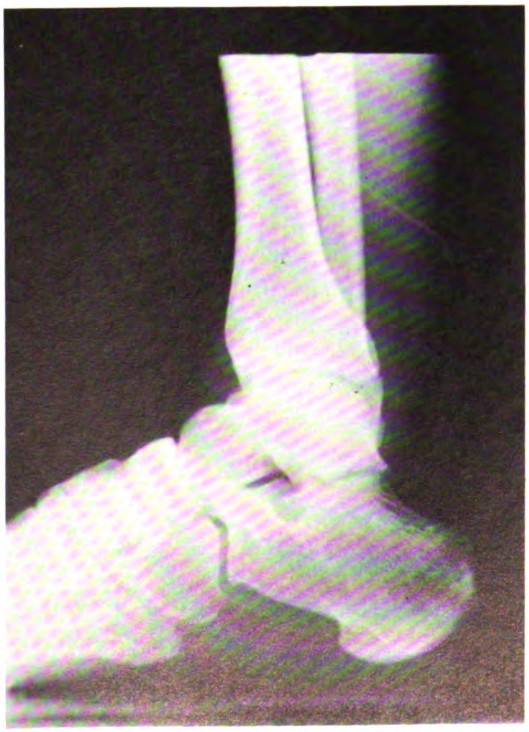
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
LATERAL	7-10	100	1/10	55-65	10	40"	YES	NO	NO	0°	8" x 10"
ANKLE	7-10	100	1	60-70	100	40"	NO	YES	NO	0°	8" x 10"

ANKLE: OBLIQUE

tructures Demonstrated:	Tibia, fibula articulation with the talus (Fig. 109D and E). Caution: rotation of ankle inward demonstrates distal end of tibia, fibula and the tarsals.
ilm Size:	8" x 10" lengthwise, for one view on one film.
ilm Identification:	ID either lateral border, right or left marker on border of film (Fig. 109A and B).
atient Preparation:	Shoe, stocking and all obstructive clothing removed.
easuring Reference:	Anterior-posterior lateral malleoli of the ankle (Fig. 109A and B).
atient Positioning:	Patient in supine position on X-ray table. Posterior aspect of leg on film-holder, with plantar surface of foot perpendicular to film. Foot and leg rotated simultaneously medially, until foot at 45° angle with film-holder (Fig. 109C).
art-Film Reference:	Posterior ankle at center of film (Fig. 109A).
entral Ray:	Perpendicular, passing through mid-point of line between lateral malleoli (Fig. 109B and C).
istance:	40 inches FFD (Fig. 109C).
Immobilization:	Sandbag against plantar portion of foot (Fig. 109A and B).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance
Variations:	Foot rotated medially for one projection, laterally for another. Regardless of rotation, the factors cited remain the same.

Figure 110. Ankle: Lateral





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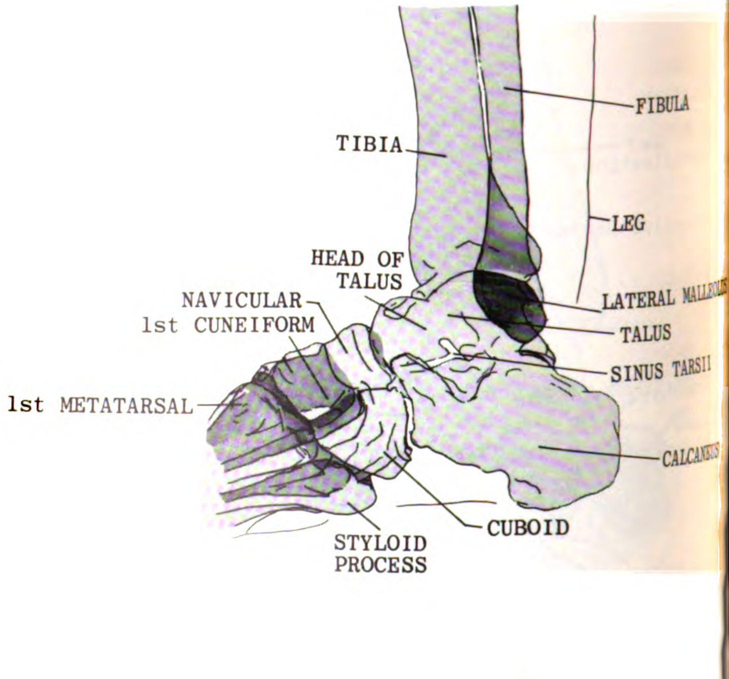


E

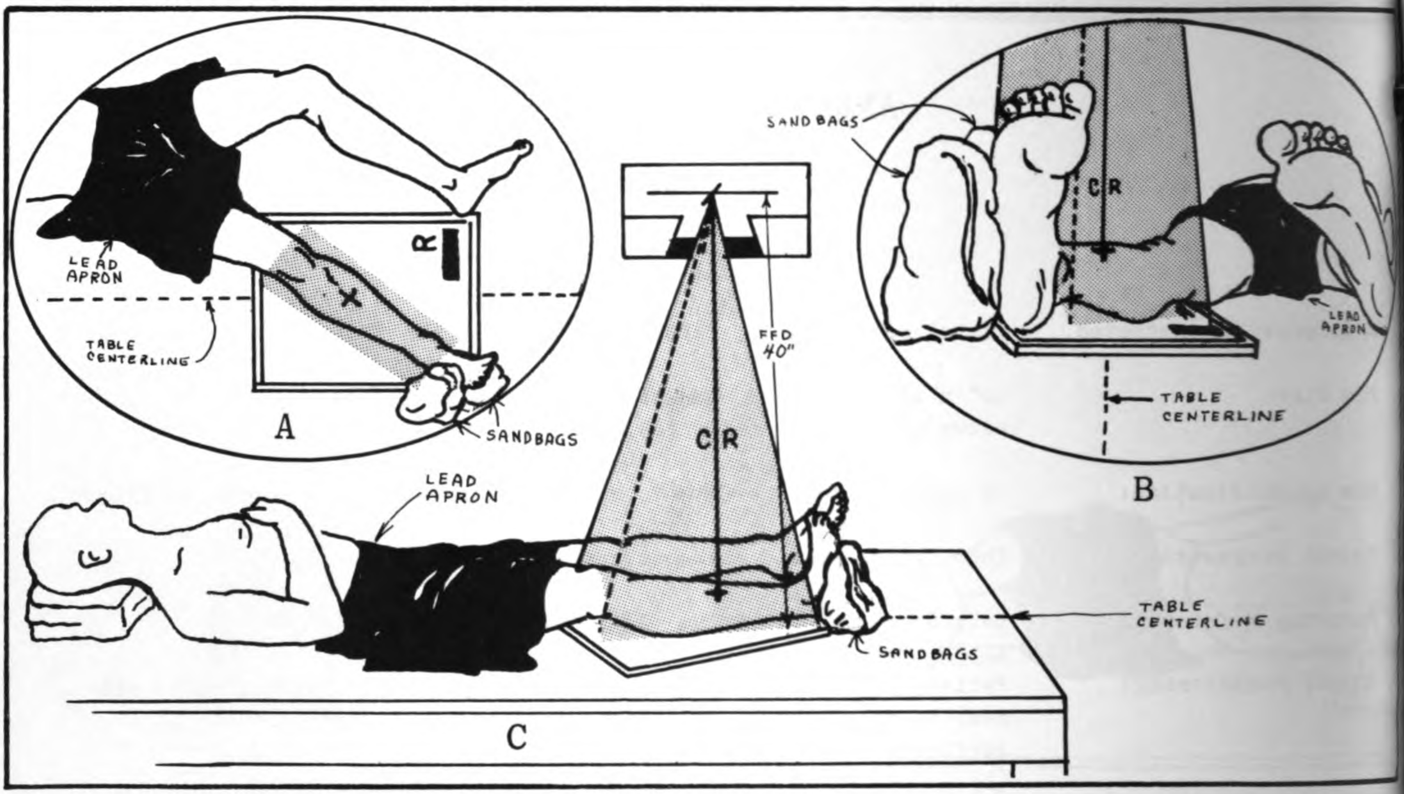
SUGGESTED STARTING TECHNIQUE

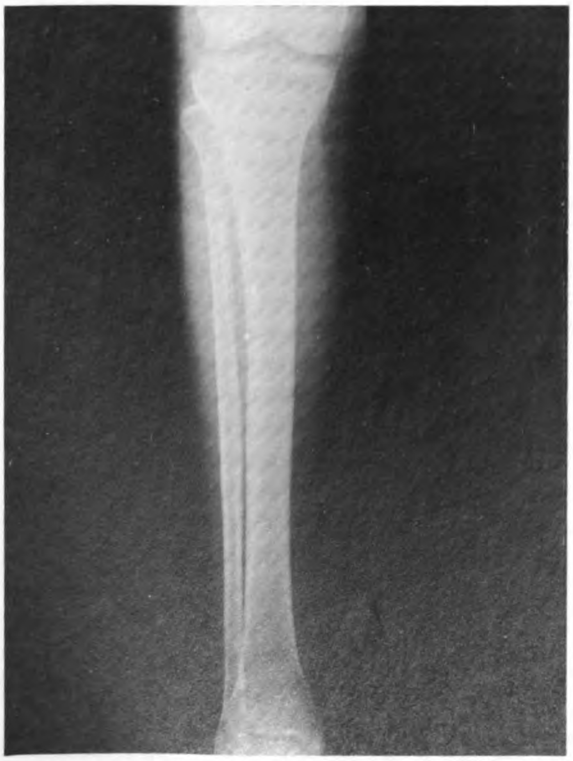
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZ
OBLIQUE	7-10	100	1/10	55-65	10	40"	YES	NO	NO	0°	10" x 12"
ANKLE	7-10	100	1	60-70	100	40"	NO	YES	NO	0°	10" x 12"

ANKLE: LATERAL

Structures Demonstrated:	Distal end of tibia, fibula and tarsal bones (Fig. 110D and E).
Film Size:	10" x 12" crosswise, one-half covered with a lead blocker for two views on one film (Fig. 110A).
Film Identification:	ID marker below calcaneus, right or left marker on border of film.
Patient Preparation:	Shoe, stocking and all obstructive clothing removed.
Measuring Reference:	Lateral-medial malleolus (Fig. 110A and B).
Patient Positioning:	Patient in lateral recumbent position on X-ray table, affected side next to film-holder. Plantar surface of foot perpendicular to surface of film-holder (Fig. 110C).
Part-Film Reference:	Lateral malleolus at center of film (Fig. 110A and B).
Central Ray:	Perpendicular, passing through medial malleolus to film-holder (Fig. 110B and C).
Distance:	40 inches FFD (Fig. 110C).
Immobilization:	Sandbag against toes (Fig. 110A, B and C).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 111. Leg: Anterior-Posterior

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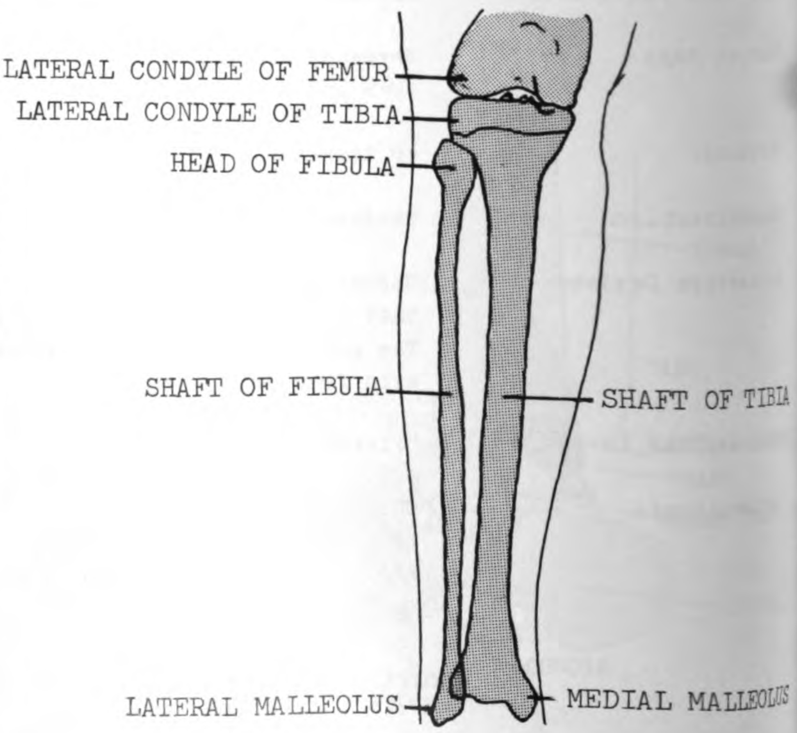


E

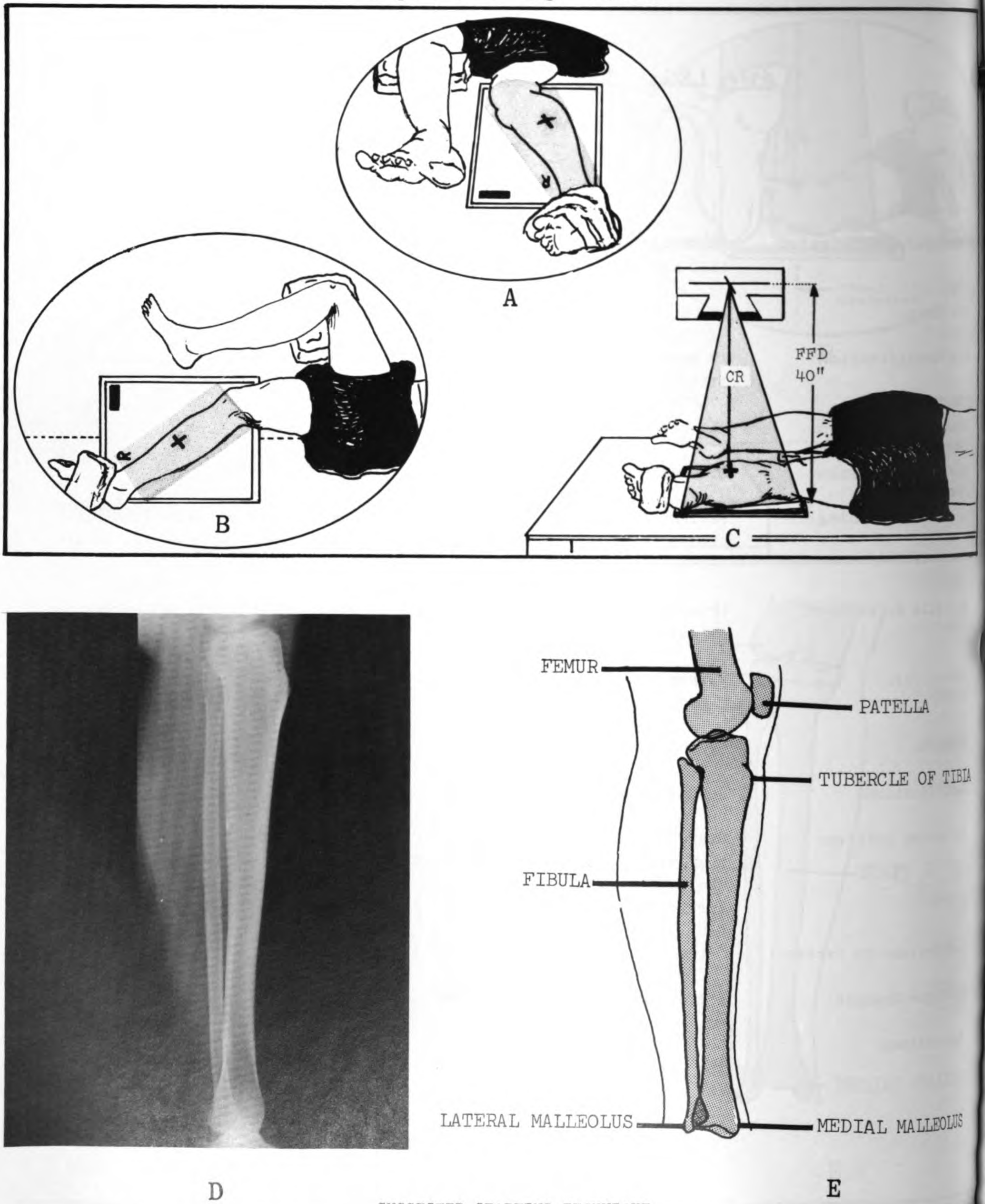
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZ
AP	9-12	100	1/10	60-70	10	40"	YES	NO	NO	0°	14" x 17"
LEG	9-12	100	1	65-75	100	40"	NO	YES	NO	0°	14" x 17"

LEG: ANTERIOR-POSTERIOR

Structures Demonstrated:	Shaft of tibia and fibula, with knee and ankle articulation (Fig. 111D and E).
Film Size:	14" x 17" diagonally for one view on one film (Fig. 111A).
Film Identification:	ID marker above ankle, right or left marker on border of film (Fig. 111A and B).
Patient Preparation:	All obstructive clothing removed.
Measuring Reference:	Mid-shaft of leg (Fig. 111A, B and C).
Patient Positioning:	Patient in supine position on X-ray table. Ankle and knee joint included on film. Leg and foot rotated inward until epicondyles parallel to surface of film-holder (Fig. 111C).
Part-Film Reference:	Proximal and distal portion of leg, including both knee and ankle joints (Fig. 111A, B and C).
Central Ray:	Perpendicular, through mid-shaft of leg, to film-holder (Fig. 111A, B and C).
Distance:	40 inches FFD (Fig. 111C).
Immobilization:	Sandbag angled against plantar surface of foot (Fig. 111A and B).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 112. Leg: Lateral



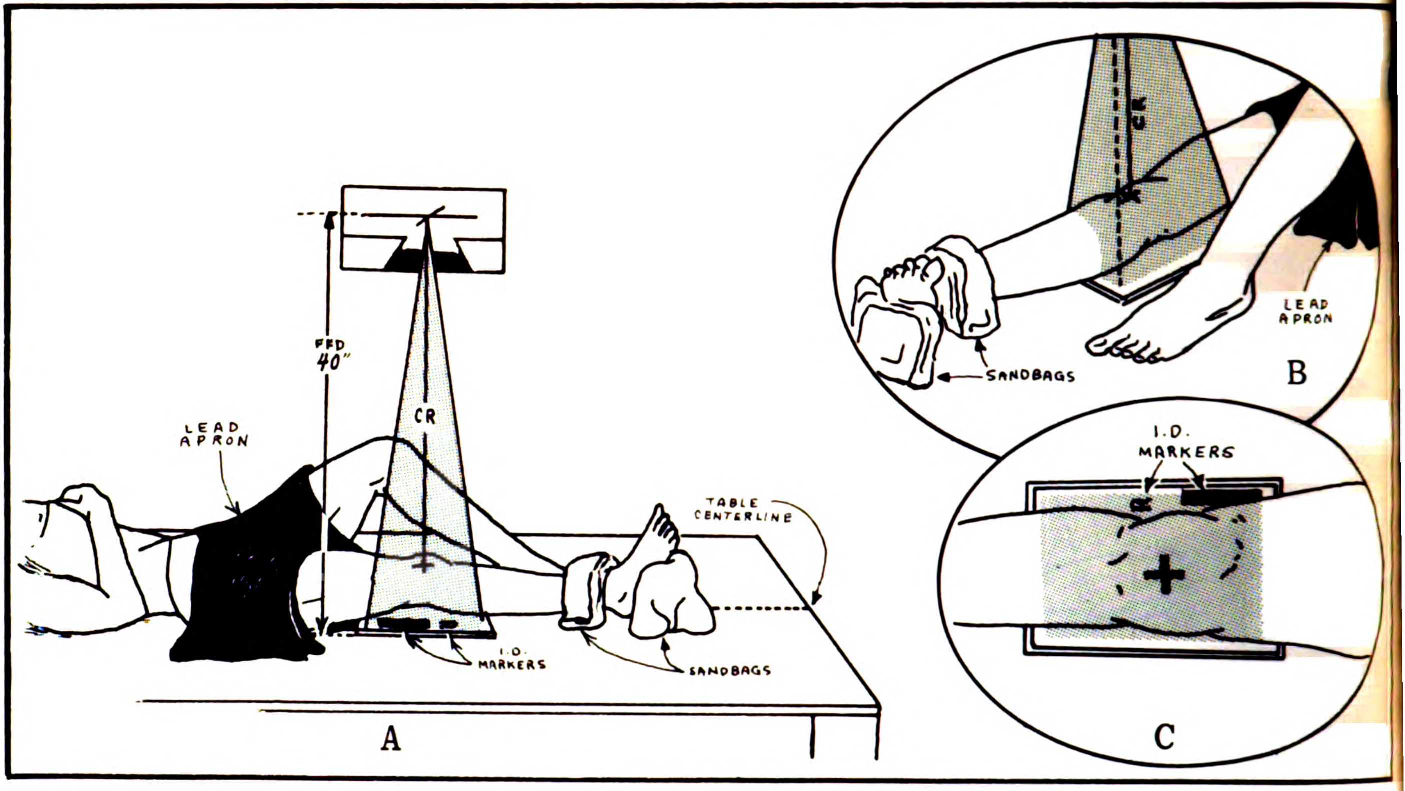
SUGGESTED STARTING TECHNIQUE

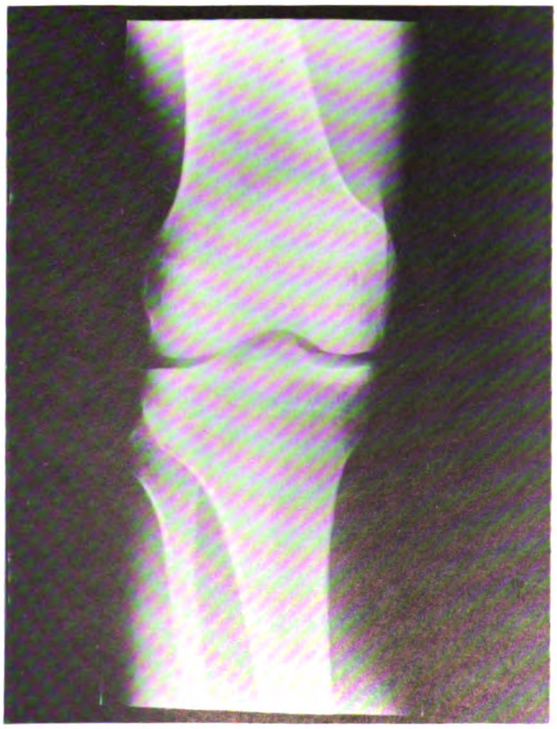
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
LATERAL	8-11	100	1/10	60-70	10	40"	YES	NO	NO	0°	14" x 17"
LEG	8-11	100	1	65-75	100	40"	NO	YES	NO	0°	14" x 17"

LEG: LATERAL

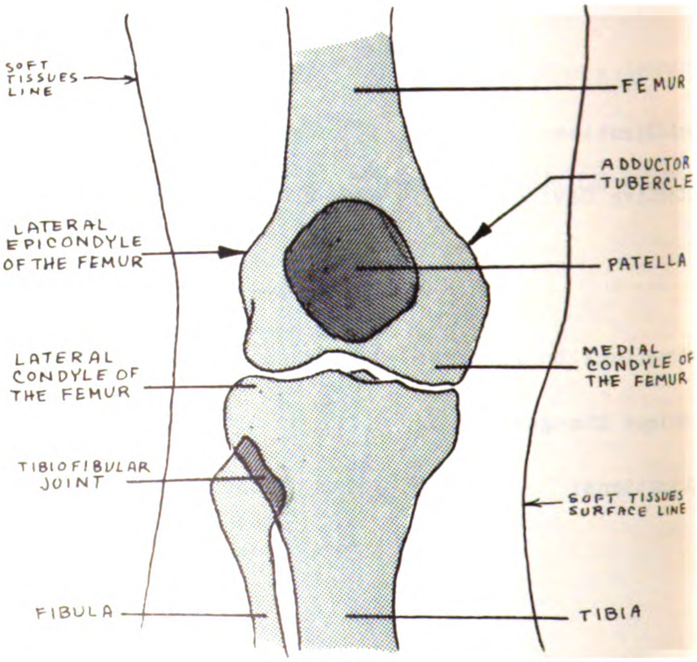
tructures Demonstrated:	Shaft of tibia and fibula, with ankle and knee joint (Fig. 112D and E).
ilm Size:	14" x 17" diagonally for one view on one film (Fig. 112 A).
ilm Identification:	ID above ankle, right or left marker on border of film (Fig. 112 A and B).
atient Preparation:	All obstructive clothing removed.
easuring Reference:	Mid-shaft of leg (Fig. 112 A).
atient Positioning:	Patient in lateral recumbent position on X-ray table. Affected leg on film-holder, appropriate joints included (Fig. 112 C). Opposite leg crossed over and out of way, sandbag under flexed knee.
Part-Film Reference:	Proximal and distal shaft of leg (Fig. 112 A, B and C).
Central Ray:	Perpendicular to shaft of leg, to center of film-holder (Fig. 112 A and C).
Distance:	40 inches FFD (Fig. 112 C).
Immobilization:	Sandbag under foot (Fig. 112A, B and C).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 113. Knee: Anterior-Posterior





D


SOFT TISSUES LINE
FEMUR
ADDUCTOR TUBERCLE
LATERAL EPICONDYLE OF THE FEMUR
PATELLA
LATERAL CONDYLE OF THE FEMUR
MEDIAL CONDYLE OF THE FEMUR
TIBIOFIBULAR JOINT
SOFT TISSUES SURFACE LINE
FIBULA
TIBIA

E

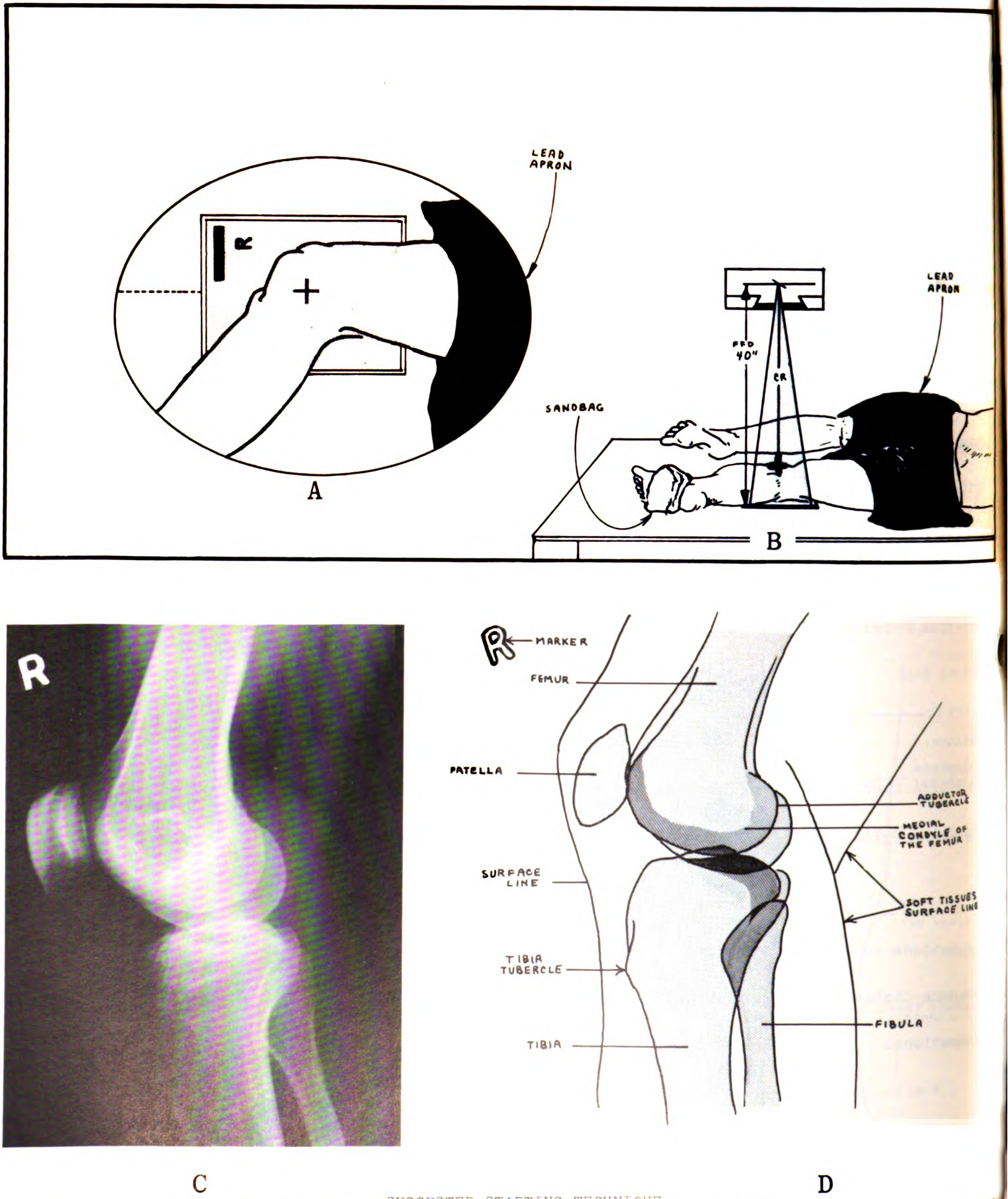
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SI
AP	10-13	100	1/10	65-75	10	40"	YES	NO	NO	0°	8" x 10"
KNEE	10-13	100	1	65-75	100	40"	NO	YES	NO	0°	8" x 10"

KNEE: ANTERIOR-POSTERIOR

Structures Demonstrated:	Proximal ends of tibia, fibula. Patella, and distal end of femur (Fig. 113D and E).
Film Size:	8" x 10" lengthwise for one view on one film (Fig. 113C).
Film Identification:	Right or left marker on border of film (Fig. 113C).
Patient Preparation:	Remove all obstructive clothing.
Measuring Reference:	Knee, at patella (Fig. 113B and C).
Patient Positioning:	Patient in supine position on X-ray table. If possible, knee flexed until thigh forms 10° angle with surface of table. Film-holder directly under flexed knee. Foot rotated medially until plane through epicondyles parallel to surface of film-holder. Inferior border of patella over film-holder (Fig. 113A).
Part-Film Reference:	Posterior knee at center of film (Fig. 113A).
Central Ray:	Perpendicular, through inferior border of patella, to film-holder (Fig. 113A and B).
Distance:	40 inches FFD (Fig. 113A).
Immobilization:	Sandbag over ankle and each side of foot (Fig. 113A and B).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	CR: Central Ray ID: Identification marker FFD: Focal-film distance
Variations:	Patient lies prone in posterior-anterior position.

Figure 114. Knee: Lateral



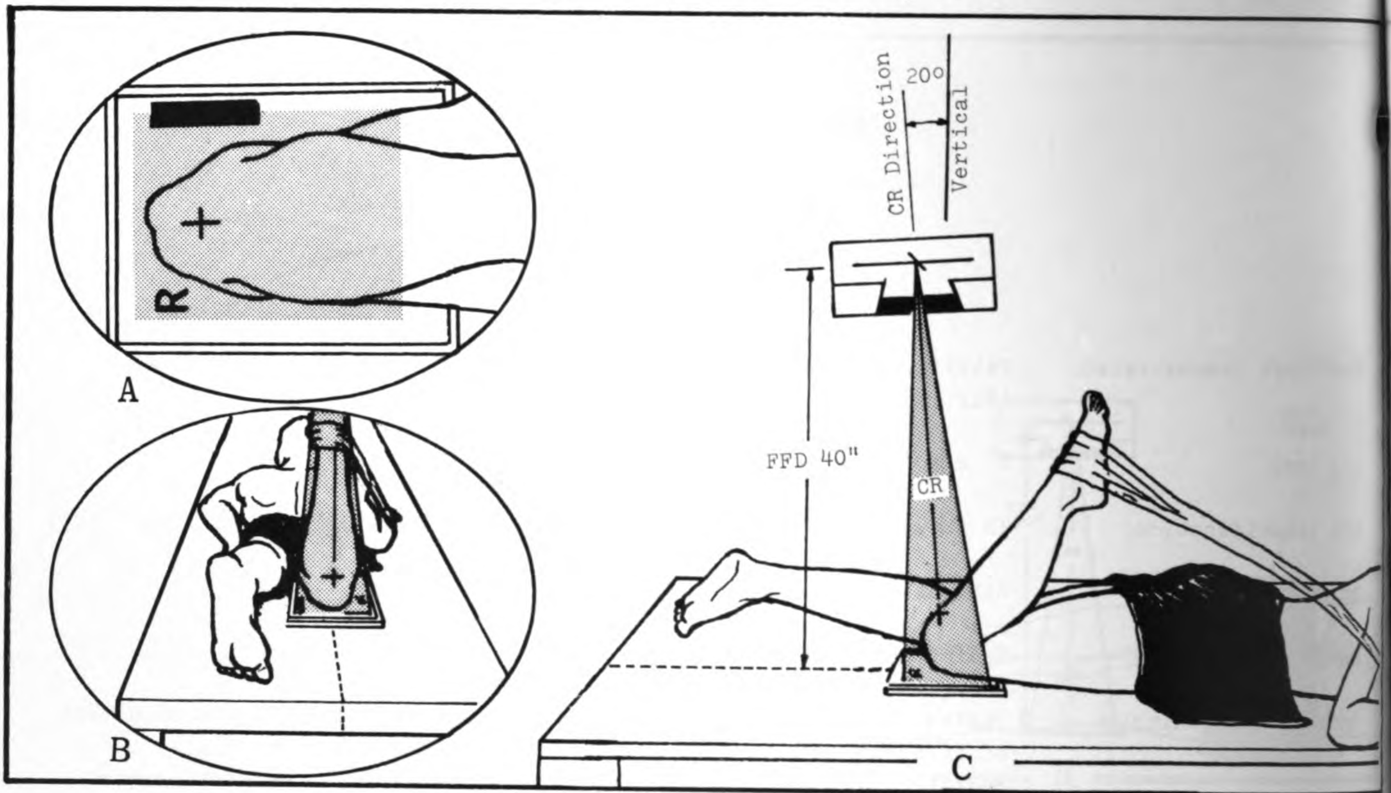
SUGGESTED STARTING TECHNIQUE

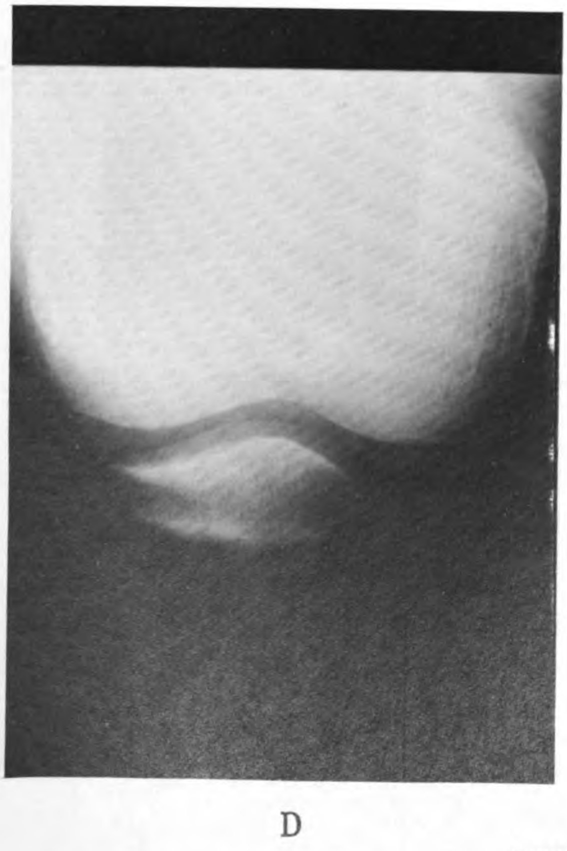
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
LATERAL	9-12	100	1/10	60-70	10	40"	YES	NO	NO	0°	8" x 10"
KNEE	9-12	100	1	65-75	100	40"	NO	YES	NO	0°	8" x 10"

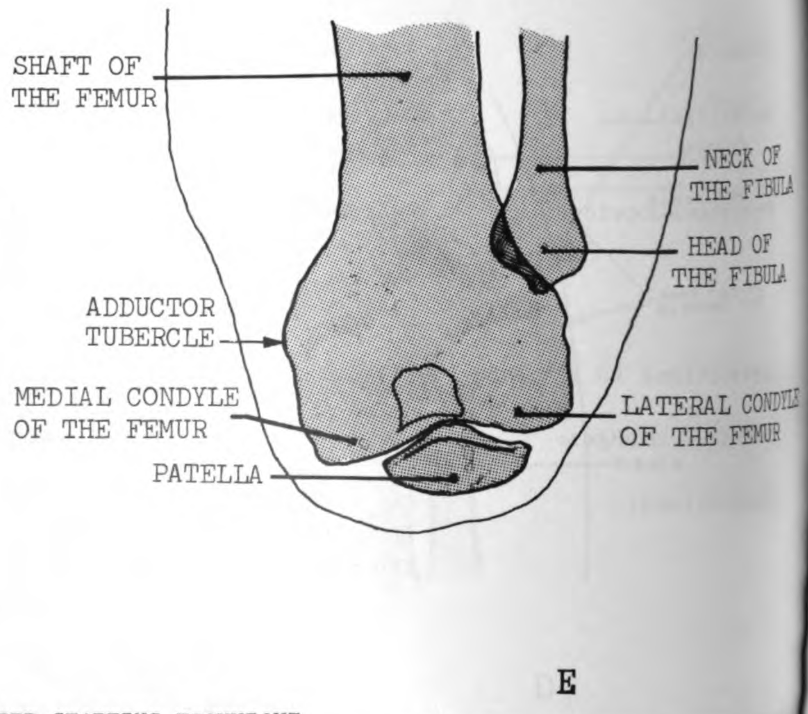
KNEE: LATERAL

Structures Demonstrated:	Patella, proximal ends of tibia, fibula and distal end of femur (Fig. 114C and D).
Film Size:	8" x 10" lengthwise for one view on one film.
Film Identification:	ID above lower leg, right or left marker on border of film (Fig. 114A).
Patient Preparation:	All obstructive clothing removed.
Measuring Reference:	Medial condyle.
Patient Positioning:	Patient in lateral recumbent position on X-ray table. Lateral aspect of affected knee on film-holder. A point one-half inch distal to medial condyle placed over center of film-holder. Condyles perpendicular to surface of film-holder (Fig. 114B).
Part-Film Reference:	Lateral knee at center of film (Fig. 114A).
Central Ray:	Perpendicular, through point one-half inch distal to medial epicondyle, to center of film-holder (Fig. 114A and B).
Distance:	40 inches FFD (Fig. 114B).
Immobilization:	Sandbag over ankle (Fig. 114B). Place a sponge or sandbag under opposite knee for support.
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 115. Knee: Inferior-Superior







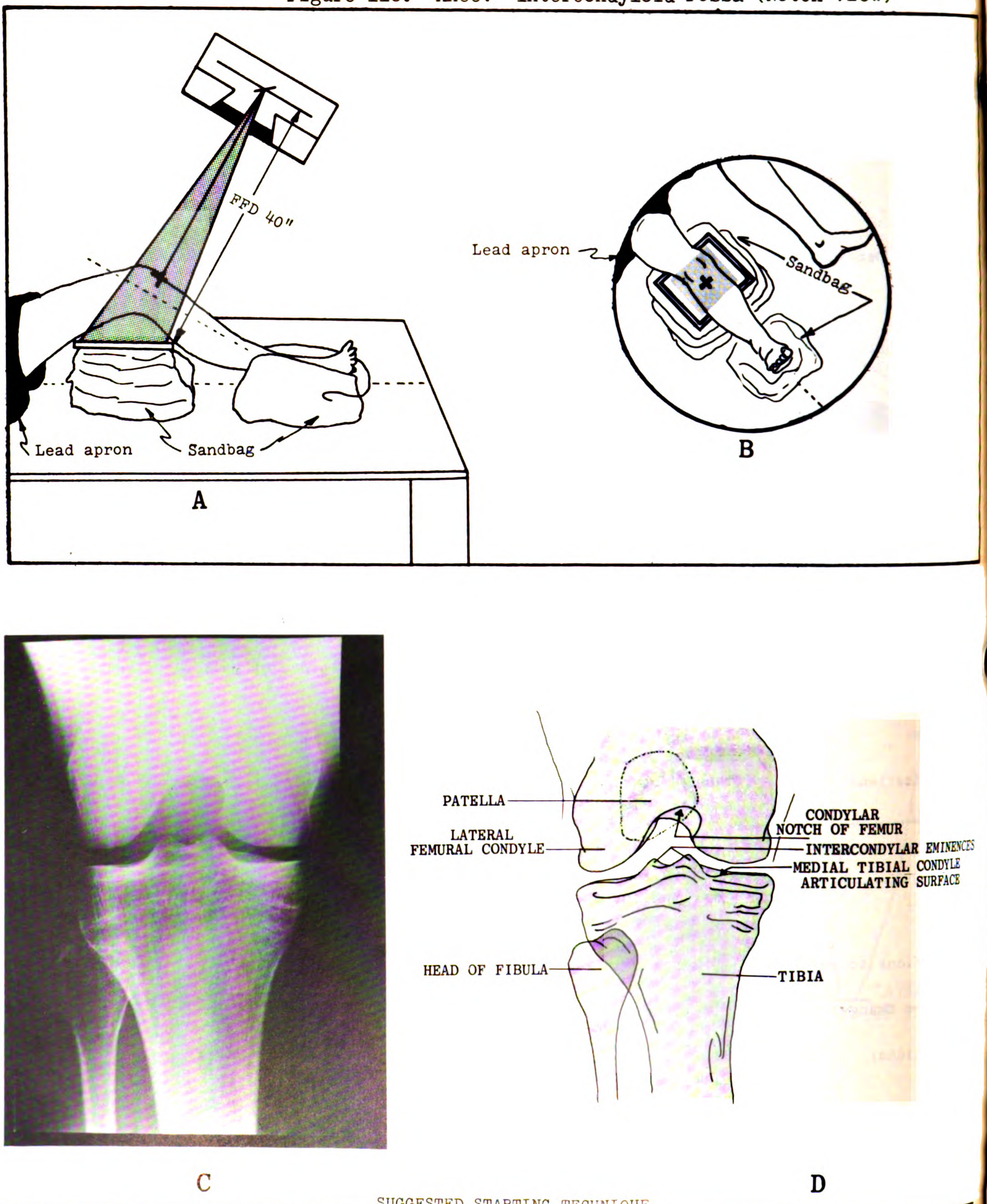
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
TANGENTIAL	11-14	100	1/10	60-70	10	40"	YES	NO	NO	20°	8" x 10"
KNEE	11-14	100	1	65-75	100	40"	NO	YES	NO	20°	8" x 10"

KNEE: INFERIOR-SUPERIOR (AXIAL OR SUNRISE VIEW)

Structures Demonstrated:	Patella and patella space (Fig. 115D and E).
Film Size:	8" x 10" lengthwise for one view on one film (Fig. 115A and B).
Film Identification:	ID below knee joint, right or left marker on border of film (Fig. 115A).
Patient Preparation:	All obstructive clothing removed.
Measuring Reference:	Inferior-superior patella (Fig. 115A).
Patient Positioning:	Patient in prone position on X-ray table. Knee flexed to form angle of 80° between thigh and leg. Epicondyles parallel to surface of film-holder. Bandage or tape wrapped around foot and pulled to flex knee (Fig. 115C).
Part-Film Reference:	Inferior border of patella at center of film (Fig. 115A).
Central Ray:	20° cephalad, passing through inferior border of patella to center of film (Fig. 115C).
Distance:	40 inches FFD (Fig. 115C).
Immobilization:	Gauze bandage, tape or other suitable material placed around foot or ankle (Fig. 115B and C).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 116. Knee: Intercondyloid Fossa (Notch View)



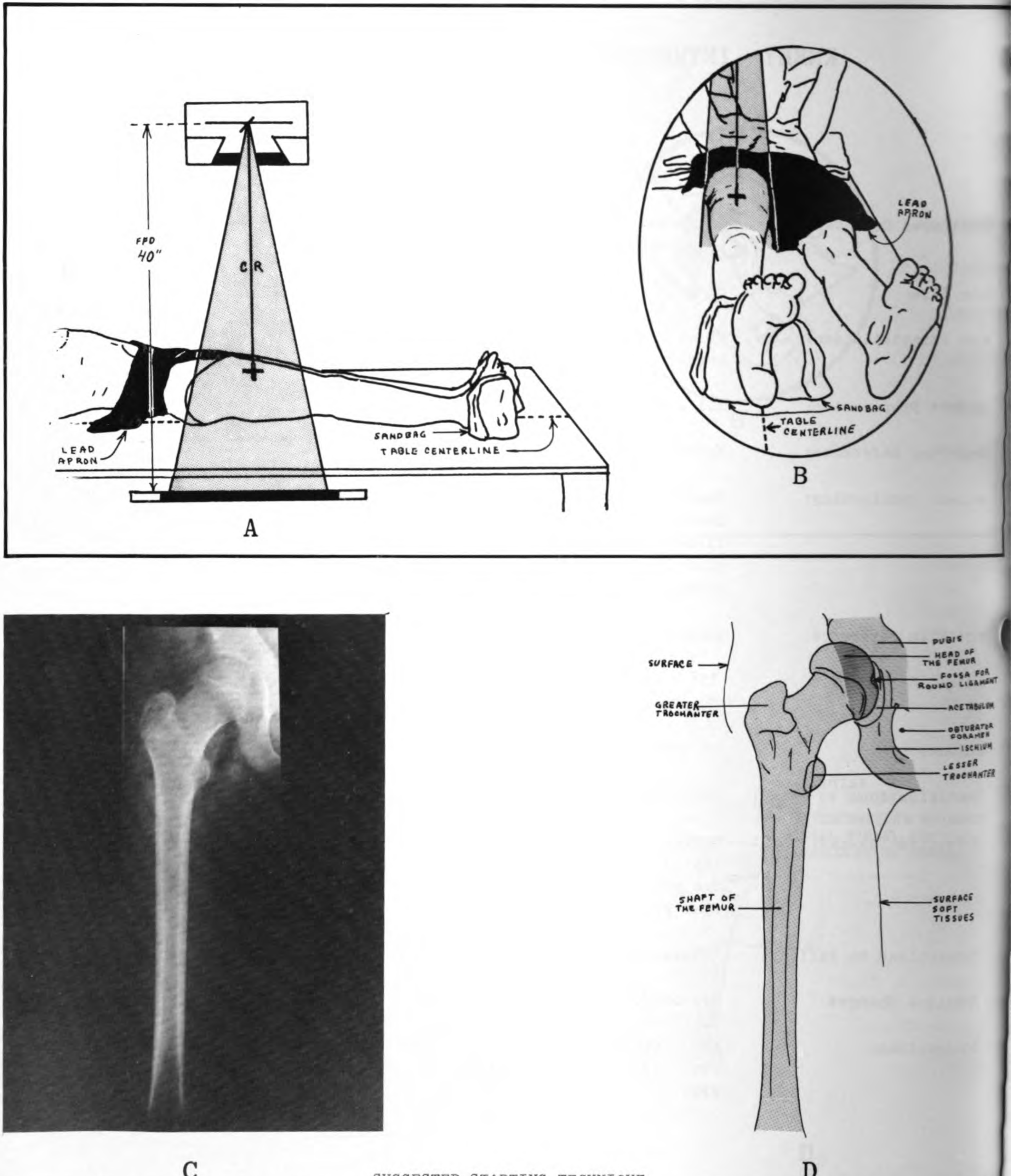
SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
KNEE, INTER-CONDYLOID NOTCH	12-16	100	1/10	65-75	10	40"	YES	NO	NO	35°	8" x 10"
	12-16	100	1	65-75	100	40"	NO	YES	NO	35°	8" x 10"

KNEE: INTERCONDYLOID FOSSA (NOTCH VIEW)

tructures Demonstrated:	Intercondyloid fossa of the femur, tibial spines and the knee joint (Fig. 116D and E).
ilm Size:	8" x 10" lengthwise, for one view on one film (Fig. 116B).
ilm Identification:	ID marker on border of film above femur. Right or left marker on border of film.
atient Preparation:	All obstructive clothing removed.
easuring Reference:	Knee, at patella (Fig. 116A).
Patient Positioning:	Demonstration of the intercondyloid fossa can be obtained with the patient supine or seated (in the Beclere position). The knee is flexed so that the leg and thigh form a 120° angle. The film is positioned parallel to the table top and supported on sandbags to bring it into close contact with the posterior aspect of the knee.
Part-Film Reference:	Anterior knee at center of film.
Central Ray:	35° cephalad and directed through the inferior border of the patella to the center of the film (Fig. 116C).
Distance:	40 inches FFD (Fig. 116C).
Immobilization:	Radiolucent blocker beneath ankle and lower leg (Fig. 116C).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead apron be placed across the upper thighs to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 117. Proximal Femur: Anterior-Posterior



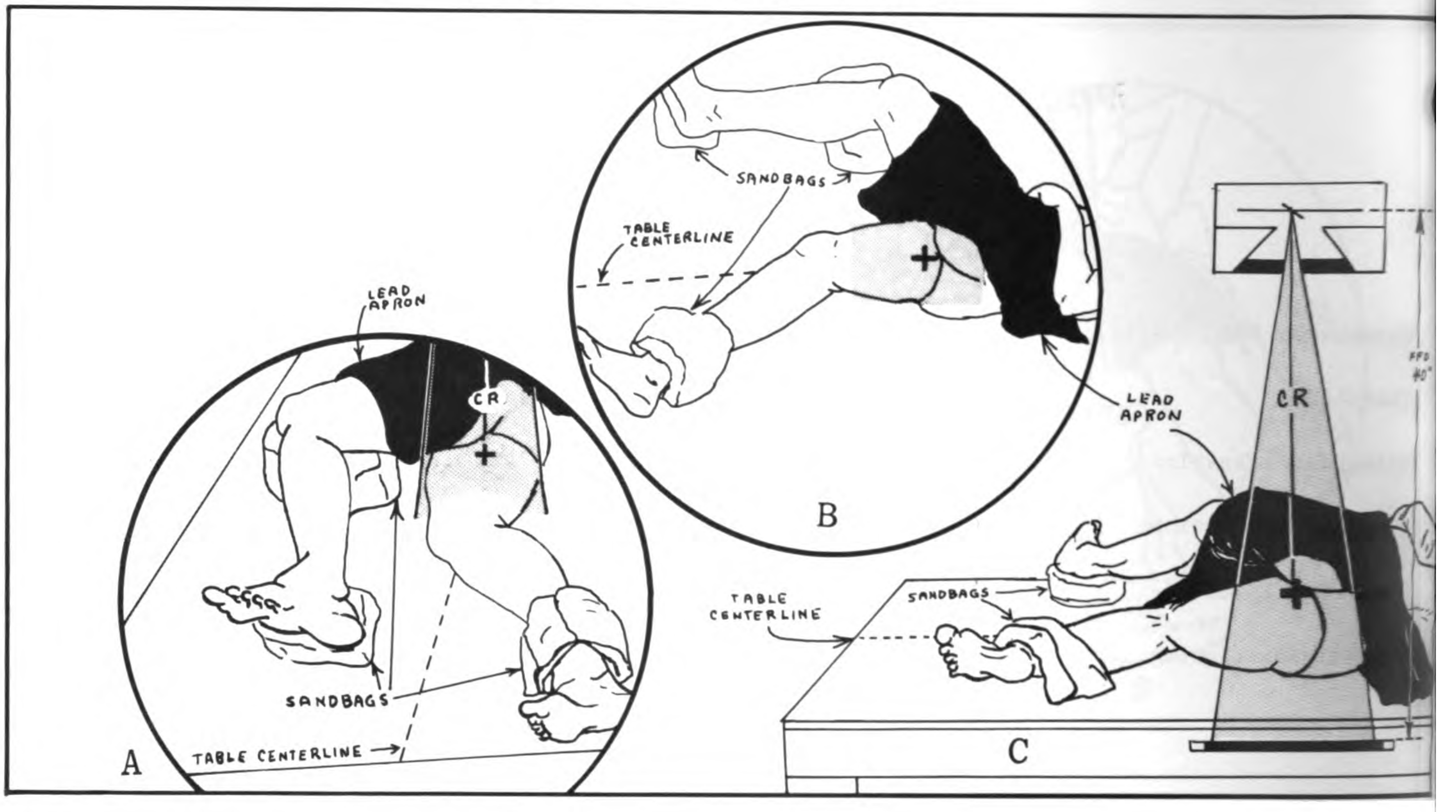
SUGGESTED STARTING TECHNIQUE

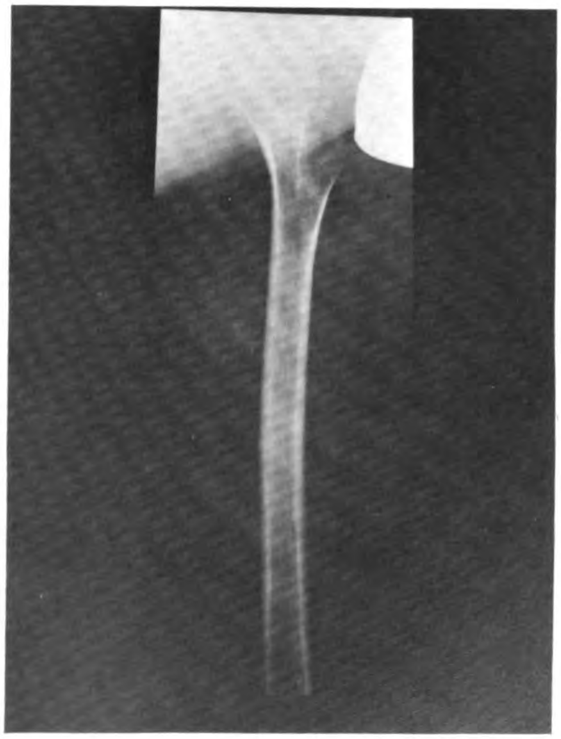
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
AP	14-18	100	7/10	65-75	70	40"	YES	NO	YES	0°	14" x 17"
FEMUR	14-18	100	1/10	70-80	10	40"	YES	NO	NO	0°	14" x 17"

PROXIMAL FEMUR: ANTERIOR-POSTERIOR

Structures Demonstrated:	Shaft of femur with one articulation (Fig. 117C and D).
Film Size:	14" x 17" lengthwise for one view on one film.
Film Identification:	ID marker on upper border, right or left marker on border of film.
Patient Preparation:	All obstructive clothing removed.
Measuring Reference:	Shaft of femur (Fig. 117A).
Patient Positioning:	Patient in supine position on X-ray table. When hip joint is included on film, inferior border of acetabulum, head and neck of femur is seen on film. Foot rotated medially until a line through head and neck of femur parallel to surface of film (Fig. 117B).
Part-Film Reference:	Lower two-thirds of femur on film (Fig. 117 A and B).
Central Ray:	Perpendicular, passing through femur to film-holder (Fig. 117 B).
Distance:	40 inches FFD (Fig. 117 B).
Immobilization:	Sandbag over lower leg, on both sides of ankle (Fig. 117 A and B).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead shield be used to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Take in a breath, hold your breath, do not move."
Technique Changes:	Changes related directly to use of cassette in Bucky or on table top. Although exposures made on young or small patients are made with cassette on table top, most examinations of the femur in the AP position utilize the Bucky. Dry or wet cast: see Glossary.
Explanations:	AP: Anterior-posterior CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 118. Femur: Lateral





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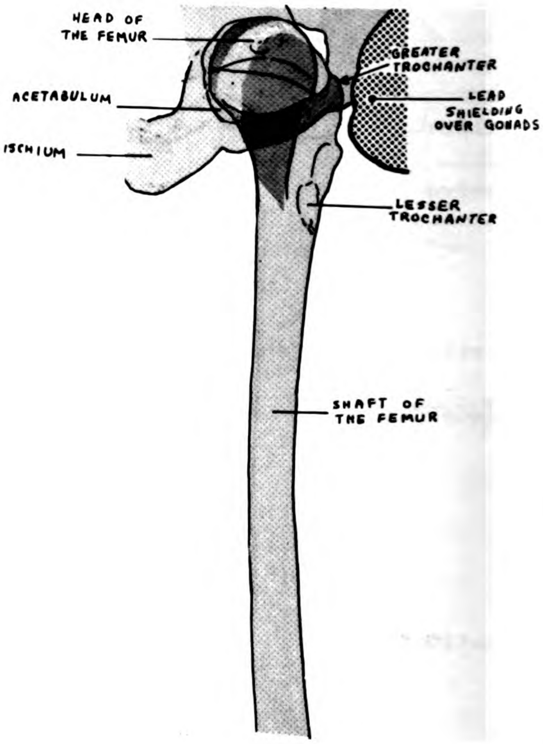


E

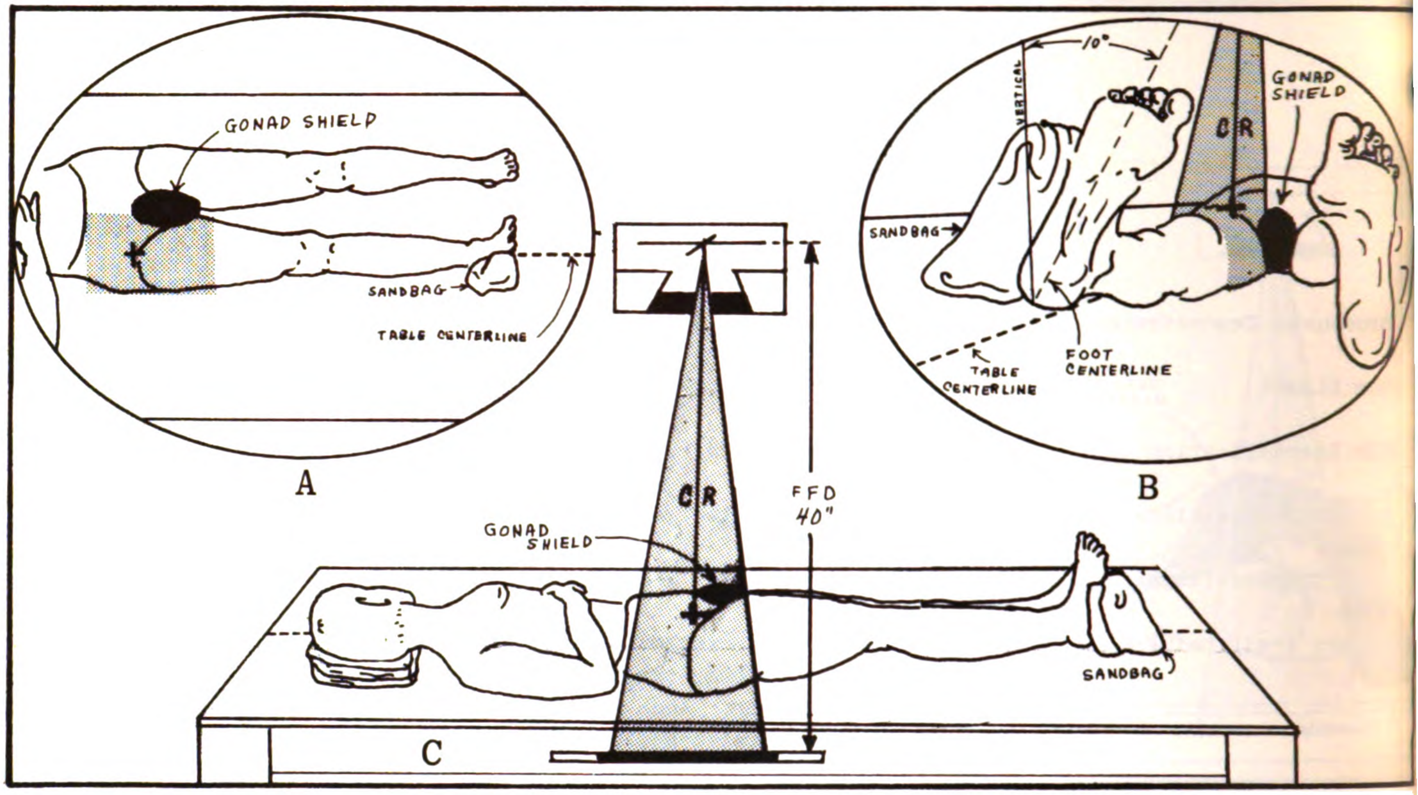
SUGGESTED STARTING TECHNIQUE

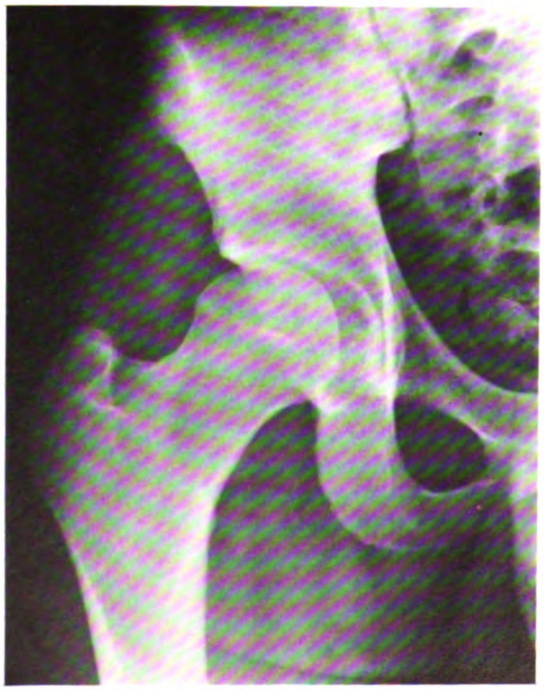
PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
LATERAL	13-17	100	7/10	65-75	70	40"	YES	NO	YES	0°	14" x 17"
FEMUR	13-17	100	1/10	70-80	10	40"	YES	NO	NO	0°	14" x 17"

FEMUR: LATERAL

Structures Demonstrated:	Shaft of femur and hip (Fig. 118D and E).
Film Size:	14" x 17" lengthwise for one view on one film (Fig. 118A).
Film Identification:	ID marker on upper border, right or left marker on border of film.
Patient Preparation:	All obstructive clothing removed.
Measuring Reference:	Mid-shaft of femur (Fig. 118B).
Patient Positioning:	Patient in lateral recumbent position on X-ray table. Affected leg next to table. Sandbag over ankle. Opposite leg brought forward, flexed sharply at hip. Knee and ankle of unaffected leg on sandbags to maintain true lateral position (Fig. 118A and C).
Part-Film Reference:	Upper two-thirds of femur on film (Fig. 118B and C).
Central Ray:	Perpendicular, passing through mid-shaft of femur to film-holder (Fig. 118C).
Distance:	40 inches FFD (Fig. 118C).
Immobilization:	Sandbags under knee and ankle of unaffected leg to maintain lateral position.
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead shield be used to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Take in a deep breath, hold your breath, do not move."
Technique Changes:	Dry or wet cast: see Glossary.
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

Figure 119. Hip: Anterior-Posterior





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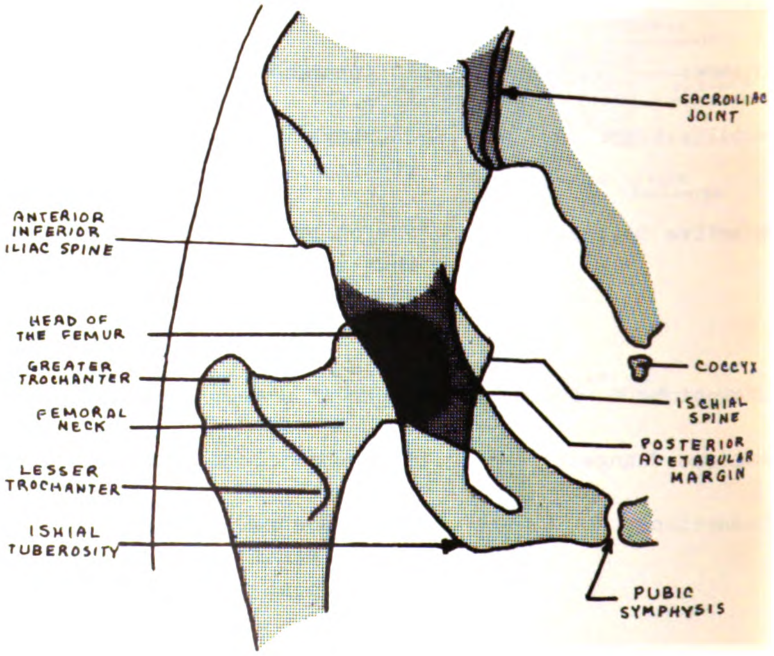


E

SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
AP HIP	16-20	100	1-1/4	75	60	40"	YES	NO	YES	0°	10" x 12"

HIP: ANTERIOR-POSTERIOR

Structures Demonstrated: Acetabulum, head and neck of femur (Fig. 119D and E).

Film Size: 10" x 12" lengthwise for one view on one film.

Film Identification: ID marker on upper border of film, right or left marker on border of film.

Patient Preparation: All obstructive clothing removed.

Measuring Reference: Hip (Fig. 119A).

Patient Positioning: Patient in supine position on X-ray table. Affected hip over mid-line of table. Foot and leg rotated 10° inward (Fig. 119C).

Part-Film Reference: Greater trochanter at center of film (Fig. 119A).

Central Ray: Perpendicular, through centering point. Directions for locating centering point: draw base line between anterior-superior iliac spine and superior margin of pubic symphysis; draw second line toward thigh at right angles to a bisecting base line; a point on second line one inch from base line becomes centering point (Fig. 119 A and C).

Distance: 40 inches FFD (Fig. 119C).

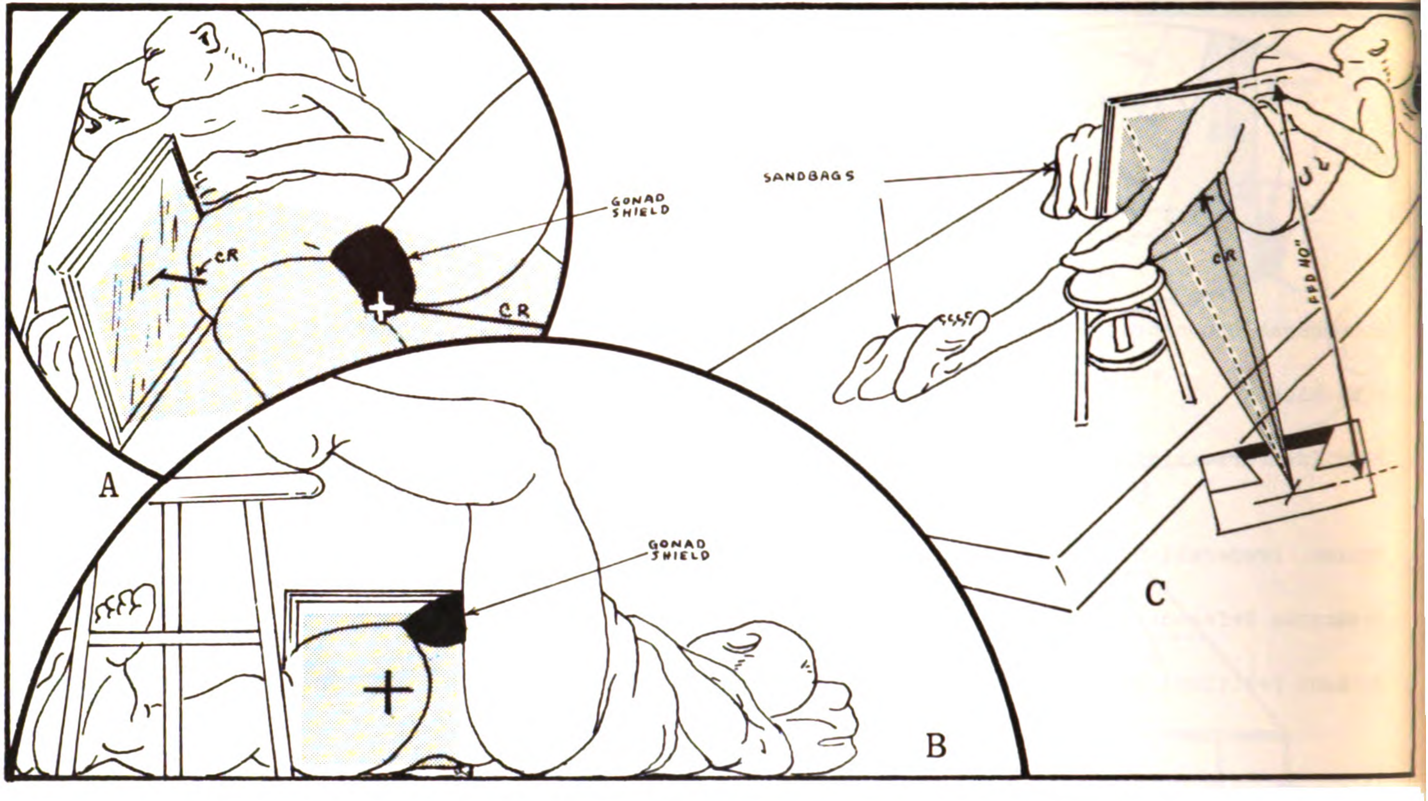
Immobilization: Foot and leg rotated 10° inward; sandbags used to immobilize foot and ankle.

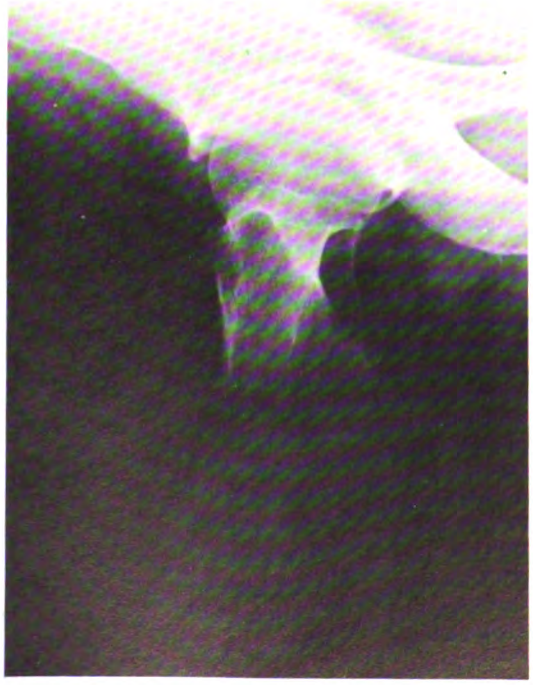
Protective Devices: Useful beam limited to area of clinical interest. It is suggested that a lead shield be used to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.

Instructions to Patient: "Hold your breath; please do not move."

Explanations:
CR: Central ray
ID: Identification marker
FFD: Focal-film distance

Figure 120. Hip: Lateral





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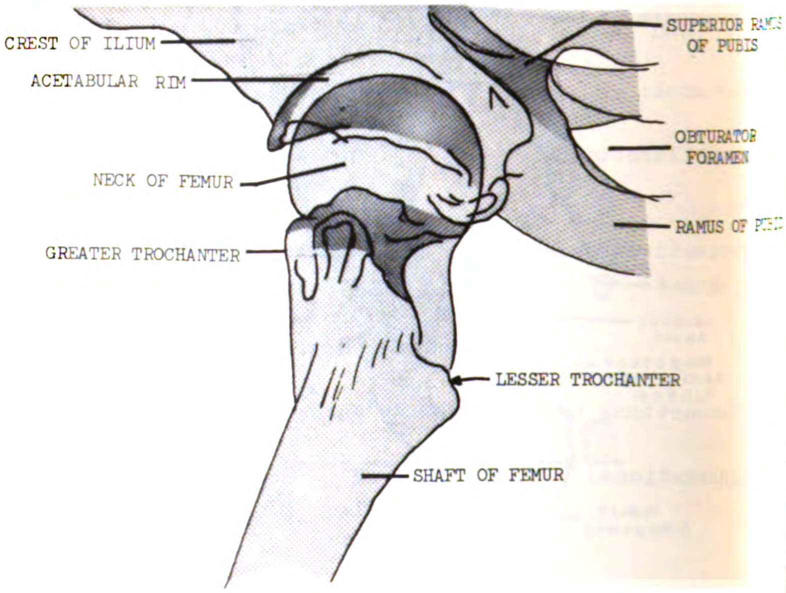


E

SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
LATERAL HIP	18-21	100	1	65-75	100	40"	YES	NO	YES	90°	10" x 12"

HIP: LATERAL

Structures Demonstrated: Acetabulum, head, neck and proximal end of femur (Fig. 120 D and E).

Film Size: 10" x 12" lengthwise for one view on one film.

Film Identification: ID marker on upper border of film, right or left marker on border of film.

Patient Preparation: All obstructive clothing removed.

Measuring Reference: Medial-lateral thigh (Fig. 120 A).

Patient Positioning: Patient in supine position on X-ray table. Affected leg extended, with slight abduction. Foot rotated 15° medially. Opposite leg flexed and elevated out of path of central ray (Fig. B and C).

Part-Film Reference: Neck of femur to film. (Position of the neck is determined by drawing a line from the head of the femur to the greater trochanter. See position for acetabulum.)

Central Ray: Horizontal, directed through upper third of thigh, bisecting and at right angles to neck of femur (Fig. 120 B and C). Caution: once angulation of the central ray has been determined, position the grid cassette at a direct right angle to the central ray. A sandbag may be placed in back of the grid cassette to hold in upright position.

Distance: 40 inches FFD (Fig. 120 B).

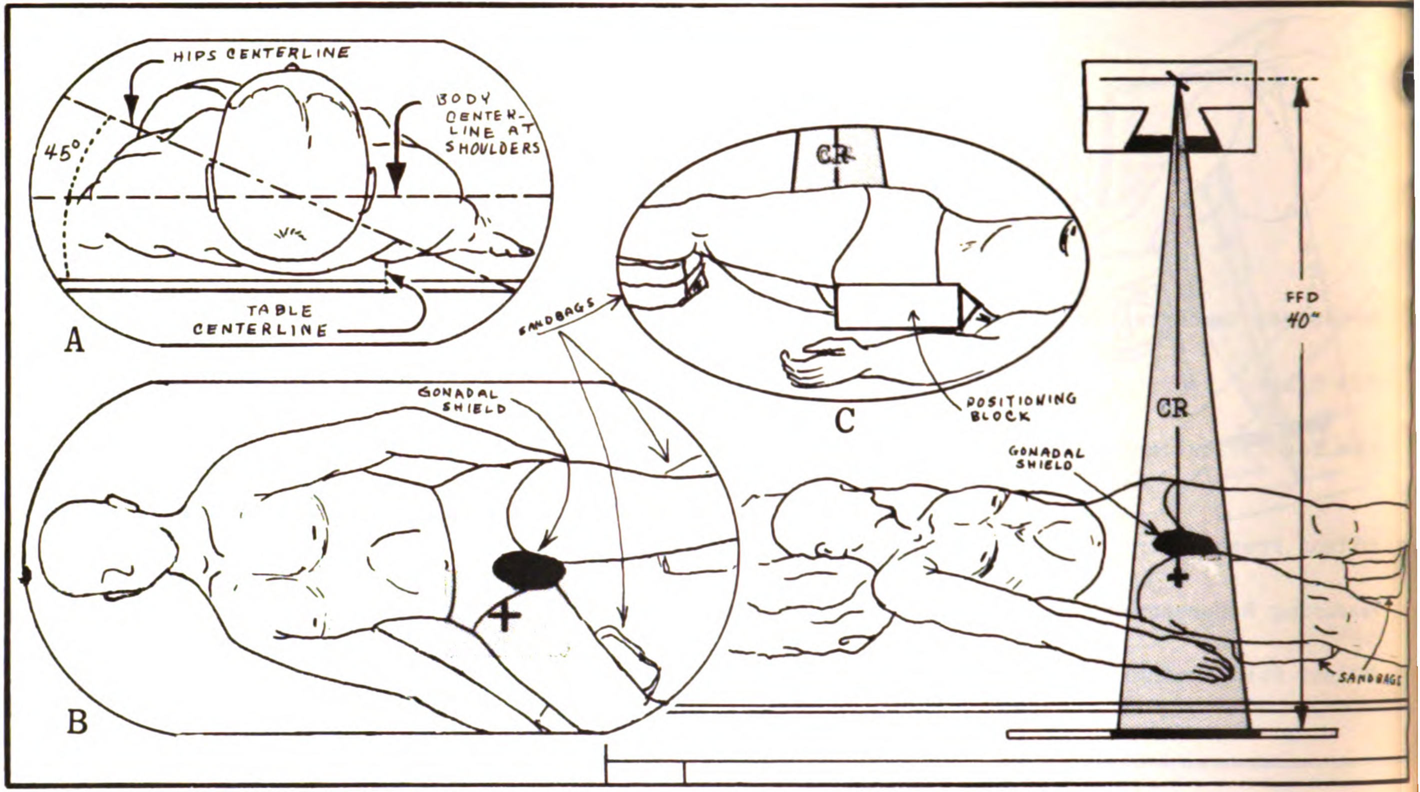
Immobilization: Sandbag over ankle of the affected hip (Fig. 120 B).

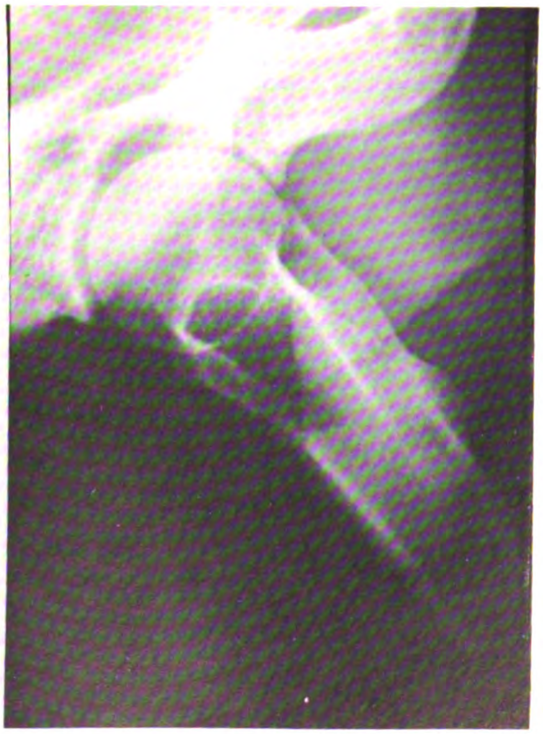
Protective Devices: Useful beam limited to area of clinical interest. It is suggested that a lead shield be used to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.

Instructions to Patient: "Hold your breath; please do not move."

Explanations:
CR: Central ray
ID: Identification marker
FFD: Focal-film distance

Figure 121. Hip: Lateral (Frog Position)





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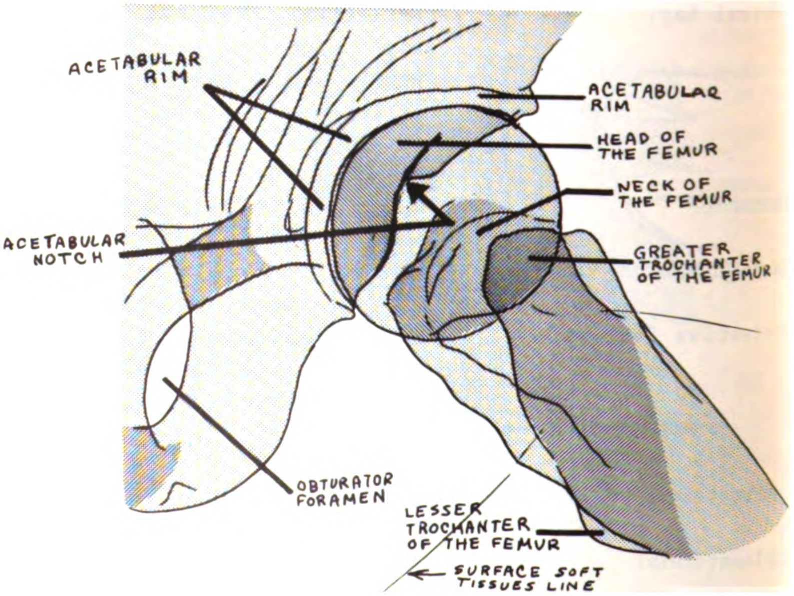

E

SUGGESTED STARTING TECHNIQUE

PART	CM	MA	SEC	KVP	MAS	DIST	SCREEN	CARDBOARD	BUCKY	TUBE TILT	FILM SIZE
FROG HIP	16-20	100	1-1/4	75	60	40"	YES	NO	YES	0°	10" x 12"

HIP: LATERAL (FROG POSITION)

Structures Demonstrated:	Lateral projection of head and neck of femur (Fig. 121E and F).
Film Size:	10" x 12" lengthwise for one view on one film (Fig. 121 D).
Film Identification:	ID marker on upper border of film. Right or left marker, on border of film.
Patient Preparation:	All obstructive clothing removed. Gown or large towel provided for coverage of body.
Measuring Reference:	Head of the femur (Fig. 121 C).
Patient Positioning:	Patient in supine position. Locate the hip joint as follows: at right angles bisect a line between the anterior-superior iliac spine and the symphysis pubis; select a point on the bisecting line two inches inferior to the first line; center this point over the center line of the table (Fig. 121 B, C and D).
Part-Film Reference:	Head of the femur to the center of the film (Fig. 121 C and D).
Central Ray:	Perpendicular through the head of the femur to center of film (Fig. 121D).
Immobilization:	Radiolucent blocker placed under the knee, and blocker under the unaffected hip (Fig. 121 B and C).
Protective Devices:	Useful beam limited to area of clinical interest. It is suggested that a lead shield be used to protect gonads. The patient should turn his head sideways to protect the lenses of his eyes from radiation.
Instructions to Patient:	"Please do not move."
Explanations:	CR: Central ray ID: Identification marker FFD: Focal-film distance

GLOSSARY

A: abbreviation for ampere.

ABDOMEN: that portion of the body which lies between the thorax and the pelvis. It consists of a cavity (abdominal cavity) which is separated by the diaphragm from the thoracic cavity.

ABDUCT: to move away from the midline of the body, or outwardly.

ABSORPTION, X-RAY: process by which radiation delivers some or all of its energy to any material through which it passes.

AC: abbreviation for alternating current.

ACCELERATOR, DEVELOPER: chemical that speeds up the activity of the developing agents. It softens the gelatin to permit the reducing agent's easy access to the exposed silver halide contained in the emulsion.

ACCESSORY: supplementary or giving aid to another similar and generally more important thing.

ACETABULUM: the large, cup-shaped cavity on the lateral surface of the hip bone in which the head of the femur articulates.

ACID, ACETIC: a colorless acid (the acid of vinegar) used in fixing solution for stopping development of the image.

ACID STOP BATH: solution of acetic or citric acid used between the developer and hypo (fixer) to stop development of image.

ACIDIFIER: acid added to fixing solution to neutralize carryover of alkaline developer.

ACOUSTIC: pertaining to sound or to the sense of hearing.

ACROMEGALY: a disease of the pituitary gland in adults which produces overgrowth of bone, especially in the jaws and hands.

ACROMION: the lateral extension of the spine of the scapula, forming the highest point of the shoulder.

ACUTE DOSE: a dose of radiation delivered at high intensity in a short time, such as seconds to a few hours.

ADDUCT: move toward the midline of the body, or inwardly.

ADENOMA: an epithelial tumor, usually benign, with a glandlike structure.

ADRENAL: a gland of the endocrine system which secretes epinephrine and is located on the proximal poles of each kidney in the human being.

AGENT, WETTING: solution used to rinse film following the washing process to accelerate the flow of water from the film surfaces and to hasten drying.

ALPHA PARTICLE: a group of two protons and two neutrons emitted energetically as a single nucleus from some radionuclides.

AMPERE: unit of electric current.

ALTERNATING CURRENT: an electric current that reverses direction periodically, usually many times per second.

ANODE: a positive electrode; specifically, the positive electrode of an X-ray tube from which the X rays are emitted.

ANTERIOR: the front part of the body or of a body structure; in front of.

ANTISEPTIC: (1) preventing decay or putrefaction; (2) a substance that will inhibit the growth and development of microorganisms without necessarily destroying them.

ANTISTATIC: pertaining to avoidance of the accumulation of static electricity on the film surface.

ANTRUM: cavity or chamber.

AORTA: the large artery arising from the left ventricle of the heart.

AP: abbreviation for Anterior-Posterior.

APEX (plural, apexes or apices): top or summit of any organ; also the pointed end.

APHAGIA: loss of the power of swallowing.

APLO: abbreviation for position, Anterior-Posterior Left Oblique.

APOPHYSEAL JOINT: the true intervertebral joint between the articular processes.

APOPHYSIS: any outgrowth or swelling, especially a bony outgrowth that has never been entirely separated from the bone of which it forms a part, such as a process, tubercle, or tuberosity.

APRON, LEADED: an apron containing lead, to protect against stray or scattered radiation, especially to the gonads.

ARTERY: a vessel that conveys blood from the heart.

ARTERIOGRAPHY: radiographic examination and study of the arteries by injection of a radiopaque solution.

ARTERIOLES: the smallest arteries leading at their distal ends into the capillaries.

ARTHRITIC: pertaining to or affected with arthritis.

ARTHRITIS: inflammation of a joint.

ARTHRODESIS: the surgical fixation of a joint by fusion of the joint surfaces.

ARTICULATE: to join together at a point in such a way as to allow movement.

ARTICULATION: a joint between bones with some degree of movement.

ARTIFACT: markings on a finished radiograph that are foreign to the image.

ASPECT: that part of a surface looking in any designated direction.

ATELECTASIS: imperfect expansion or collapse of the air vesicles of the lungs.

ATLAS: first cervical vertebra.

ATOM: smallest quantity of an element that can exist and still retain the properties of that element.

ATOM, IONIZED: an atom or molecule that has gained or lost one or more electrons. By this ionization, it becomes electrically charged.

ATRIUM (plural, atria): one of the pair of smaller cavities of the heart, with thin muscular walls, from which blood passes to the ventricles.

ATROPHY: a defect or failure of nutrition manifested as a wasting away or diminution in the size of a cell, tissue, organ or part.

ATTENUATION, X-RAY: the process by which the X-ray beam is reduced in intensity when passing through some material. It is the combination of absorption and scattering processes.

ATYPICAL: irregular; not conforming to type.

AUDITORY: pertaining to the sense of hearing.

AUDITORY MEATUS: the opening of the ear.

AURICLE: (1) an atrium of the heart; (2) the portion of the external ear not contained in the head, also called the pinna.

AUTOPSY: the post-mortem examination of the body.

AXILLA (plural, axillae): armpit.

AXIS: (1) line about which a revolving body turns or about which a structure shows symmetry; (2) the second cervical vertebra.

BACKGROUND RADIATION: ionizing radiation that is always present. It consists of cosmic rays from space, naturally occurring radiation from the earth and buildings around us, and radiation from radioactive materials within our own bodies.

BACK-SCATTER: X rays reflected when the primary beam, after penetrating the object, strikes a surface beneath the object.

BASE: expanded end of bone opposite to its head.

BASILAR: pertaining to a base or basal part.

BEAM, PRIMARY: those X rays which pass through the aperture, cone, or other collimator.

BEAM, X-RAY: an approximately unidirectional flow of electromagnetic radiation (X ray). The center of the beam is known as the central ray (CR).

BENIGN: not malignant; favorable for recovery.

BETA PARTICLE: an energetic electron emitted from the nucleus of some radionuclides.

BICIPITAL GROOVE: a furrow located between the two tuberosities of the humerus.

BILATERAL: having two sides, or pertaining to both sides.

BIOPSY: removal and examination of tissue from the living body for diagnostic purposes.

BISECT: to divide into two equal parts.

BRACHIAL: relating to the arm.

BRONCHIAL TREE: the bronchi and their branching structures.

BRONCHUS: (plural, bronchi): an air tube; one of the divisions of the trachea.

BUCKY DIAPHRAGM (Potter-Bucky diaphragm): device used in radiography consisting of a sliding grid of leaded strips so arranged as to reduce the effect of secondary radiation on a radiograph; also called a Bucky grid or simply a Bucky.

BUCKY TRAY: sliding metal tray to hold a cassette beneath the table top and grid.

BURSA: a small liquid-filled sac that occurs between parts that move upon one another.

BURSITIS: inflammation of a bursa.

CALCANEUS: the heel bone, largest bone of the tarsus; the os calcis.

CALCIUM TUNGSTATE: a phosphor used in medium speed intensifying screens.

CALIPER: instrument used to measure the thickness or diameter of a part.

CALIBRATE: to compare the readings of a measuring instrument with some fixed standard or with another instrument.

CALLUS: a new growth of incomplete osseous tissue surrounding the ends of a fractured bone that is in the process of healing.

CANCELLOUS BONE: bone having a reticular, spongy, or latticelike structure.

CANCER: any type of malignant growth.

CAPILLARY: any one of the minute vessels that connect the arterioles and venules, forming a network in nearly all parts of the body.

CARCINOGEN: any cancer-producing substance.

CARCINOMA: a malignant new growth made up of epithelial cells.

CARDBOARD HOLDER: a lightproof holder made of cardboard used for holding certain types of X-ray film. The back side contains a thin sheet of lead to reduce back-scatter.

CARPAL BONES: the small bones of the wrist; eight in number. The navicular or scaphoid, lunate or semi-lunar, triquetum or triangular, greater and lesser multangular, capitate or os magnum, hamate and pisiform.

CARPUS: same as carpal bones.

CARTILAGE: connective tissue containing no vascular network.

CASSETTE: device with intensifying screens for holding X-ray films during exposure.

CAST RADIOGRAPHY: (1) dry cast: for low kilovoltage techniques, measure the part and add 10 kVp; (2) wet cast: for low kilovoltage techniques measure the part and add 15 kVp. It is better to alter kVp than mAs. If, however, one prefers to use mAs, the correction factor would be to double the mAs (2 x mAs).

CATARACT: a condition of the lens of the eye in which the lens become opaque.

CATHODE: a negative electrode; specifically, the negative terminal in an X-ray tube which acts as the source of electrons.

CAUDA (plural, caudae): tail, or tail-like appendage.

CAUDAD: directed toward the feet; opposite to cephalad.

CAUDAL: (1) pertaining to the cauda; (2) denoting a position more toward the cauda; same as inferior, in human anatomy.

CAUDAL ANGULATION: PA, AP or lateral projection in which the central ray (CR) enters nearer the cephalic and exits nearer the caudal aspect.

CELL WALL: the membrane enclosing the contents of a cell.

CENTRAL RAY: the pencil of radiation at the geometric center of the primary beam. Abbreviated CR.

CEPHALAD: toward the head; opposite to caudad.

CEPHALIC: pertaining to the head.

CEPHALIC ANGULATION: PA, AP or lateral projection in which the central ray (CR) enters nearer the caudad and exits nearer the cephalad.

CEREBRUM: the main portion of the brain occupying the upper part of the cranium; the two cerebral hemispheres, united by the corpus callosum, forming the largest part of the central nervous system in man.

CERTIFIED RADIOLOGIC TECHNOLOGIST: same as X-ray technologist.

CERVICAL: pertaining to the neck or any neck-like structure.

CHAMBER: compartment or closed space.

CHEMICAL FOG: see fog, chemical.

CHROMOSOMES: the structures found in cell nuclei that carry the hereditary apparatus of the individual. They contain the genes, or hereditary factors, and are normally constant in number for each species.

CHRONIC DOSE: a dose of radiation delivered over a long time, such as days to years.

CIRCUMFLEX: winding around, curved like a bow.

CLAVICLE: the collar bone; extends between its joint with the acromion process of the scapula to its joint with the sternum near the midline.

CLINICAL: pertaining to the course of a disease, or the symptoms.

COCCYX: the small bone caudad to the sacrum in man, formed by union of four (sometimes five or three) rudimentary vertebrae, and forming the caudal extremity of the vertebral column.

COLLATERAL: (1) secondary or accessory; not direct or immediate; (2) a small side branch, as of a blood vessel or nerve.

COLLES' FRACTURE: fracture of the distal end of the radius.

COLLIMATOR: a device which restricts the size of the primary X-ray beam.

COMMINUTED: a bone is splintered or crushed.

COMPACT BONE: external bony substance composed of dense, osseous material.

COMPARISON: the act or process of comparing; identity of features; similarity.

COMPRESSION (of tissues): compression of body tissues serves to reduce the thickness of tissue being radiographed. It makes possible a reduction in mAs, the production of secondary radiation fog, and the depth of tissue to be penetrated.

CONDYLE: smooth, rounded swelling of the articular end of a bone.

CONE: accessory apparatus that aids in controlling secondary radiation by limiting the spread of the X-ray beam. By limiting the volume of tissue exposed, secondary radiation which would otherwise be generated in adjacent areas is avoided. It is made of radiopaque metal in various sizes and may be fitted to the X-ray tube portal.

CONGENITAL: existing at, and usually before, birth; referring to conditions that are present at birth, regardless of their causation.

CONNECTIVE TISSUE: one of the four main tissues of the body; a fibrous tissue concerned primarily with supporting bodily structures and binding parts together.

CONSTRICTION: the narrowing of the lumen or opening of a tubular structure.

CONTRAST: difference in densities between points on a film; same as radiographic contrast.

CONTRAST, EMULSION: ability of the emulsion to affect the contrast of the radiograph under specific conditions of exposure, development, and type of tissue being examined. Different emulsions can produce different contrasts despite the same exposure and development.

CONTRAST, FILM: that component of the radiographic contrast that depends on film type, screen type, density level (which depends on kVp and mAs), and processing.

CONTRAST, LONG-SCALE: contrast in which many translucent densities are present, making possible the visualization of an abundance of image details.

CONTRAST, RADIOGRAPHIC: radiographic contrast comprises the differences in film density that enable image details to become visible. Whenever there is a visible difference in the light transmission between two or more densities on a radiograph, radiographic contrast is said to exist. Contrast is directly influenced by the applied kilovoltage, the proportion of secondary radiation, and the character of the tissues being examined.

CONTRAST, SHORT-SCALE: contrast in which the transition between densities is large and exaggerated. Silver deposits (details) representative of both thick and thin parts are seldom shown. Detail visibility in these image areas is diminished and in most instances is diagnostically worthless. Opacities and absence of image silver denote short-scale contrast.

CONTRAST, SUBJECT: that component of the radiographic contrast that arises from differences in X-ray absorption by the part being examined; depends on tissue densities and thicknesses, kVp, and degree of scatter (hence, on collimation and use of a grid).

CONTRAST, TISSUE: refers to the relative differences in tissue density and thickness of the components of an anatomical part with respect to their X-ray absorbing properties. Radiographically, tissue contrast is evidenced by the variations in radiographic densities caused by the differences in absorbing power of the different kinds of tissues.

CORACOID: shaped like a crow's beak; a process of the scapula.

CORONAL PLANE: any vertical plane parallel to the front of the body, extending from left to right and separating anterior from posterior.

CORONOID: crown-shaped; processes found on the mandible and ulna.

CORTEX: outer layer of an organ or other body structure, as distinguished from the underlying substance.

CORTICAL: pertaining to or of the nature of a cortex.

COSTAL: pertaining to a rib or ribs.

COSTOPHRENIC: pertaining to the costal and diaphragmatic pleurae.

COSTOPHRENIC ANGLE: angle formed by the lateral junction of the ribs with the diaphragm.

COULOMB: a quantity of electricity equal to an ampere-second.

CR: abbreviation for central ray.

CRANIUM: skull; the bony structure housing the brain.

CREST: the peak of an electromagnetic wave form.

CUBITAL: pertaining to space in front of elbow joint.

CUBOID: lateral bone of the tarsus between the calcaneus and fourth and fifth metatarsals.

CUNEIFORM: wedge-shaped; bones of the tarsus, first, second and third.

CURRENT: the stream of electricity which moves along a conductor. An electric current is due to a difference of potential between two points, this difference being measured in volts. The rate of flow depends on the difference of potential and the resistance to be overcome (for AC, inductance also) and is measured in amperes. The quantity of electricity delivered by a current in a stated time is measured in coulombs.

CURRENT, ALTERNATING: see alternating current.

CURRENT, DIRECT: see direct current.

CYCLE: one complete interval of a wave or an alternating current to the point where it just begins to repeat itself.

CYST: sac, normal or abnormal, especially one which contains a liquid or semisolid material.

CYTOPLASM: the contents of a cell, exclusive of the nucleus.

DACTYL: a digit, either finger or toe.

DARKROOM: a processing room where X-ray film is loaded into light-proof holders in preparation for exposure and where it is returned for processing into a finished radiograph.

DC: abbreviation for direct current.

DECUBITUS: recumbent or horizontal position; a "lying down" position.

DEFINITION: in radiography, the degree of distinction with which radiographic details are recorded on an X-ray film.

DEGLUTITION: act of swallowing.

DENSITY, FILM OR RADIOGRAPHIC: a measure of the extent of deposit of black, metallic silver in the X-ray film emulsion produced by X-ray exposure and subsequent processing.

DENSITY, REGULATION OF: when a fixed kilovoltage is employed, the radiographic density is regulated by increasing or decreasing the milliampere-seconds to a correct value so that the remnant radiation will be sufficiently intense to produce a satisfactory image.

DENTURES: a full set of teeth; specifically, of artificial teeth.

DETAIL, RADIOGRAPHIC: the degree to which the structural configuration of body tissues is made visible in the form of a radiographic image.

DEVELOPER: a chemical or combination of chemicals that changes the silver halides of a latent image to metallic silver.

DEVELOPER RESTRAINER: chemical (potassium bromide) used in a developer to check development of the unexposed silver bromide and to control the working speed of the developer with respect to the exposed silver bromide.

DEVELOPMENT: the chemical process of converting exposed silver halides (latent image) to black, metallic silver (silver image).

DIAPHRAGM: (1) the musculomembranous partition separating the abdominal and thoracic cavities; (2) in radiography, a device composed of a sheet of radiopaque lead or brass in which is cut an aperture to permit X-ray coverage of a desired film area. Its function is similar to that of a cone.

DIAPHRAGM, BUCKY OR POTTER-BUCKY: see Bucky diaphragm.

DIAPHYSIS: shaft of a long bone.

DIGIT: a finger or toe.

DIASTOLE: the period during which the heart muscle relaxes and the chambers (especially the ventricles) fill with blood. Opposite of systole.

DILATATION: condition of being dilated or stretched beyond the normal dimensions.

DIRECT CURRENT: electric current which flows in only one direction in a conductor. Abbreviated DC.

DISTAL: farthest from the middle of the body or the origin of the organ. Opposite to proximal.

DISTANCE, FOCUS-FILM: distance from the focal spot (FS) of the X-ray tube to the X-ray film. Abbreviated FFD. Also called target-film distance (TFD).

DISTANCE, OBJECT-FILM: distance from the body part being examined to the X-ray film.

DISTANCE, TARGET-FILM: same as distance, focus-film. Abbreviated TFD.

DISTANCE, TARGET-SKIN: distance between the X-ray tube anode and the skin of the patient. It is used more frequently in X-ray therapy than in radiography. Abbreviated TSD.

DISTORTION, IMAGE: difference of size or shape of the X-ray image from the true size or shape of the body part being examined.

DNA: abbreviation for deoxyribonucleic acid, the complex molecule which, by the arrangements of certain of its atoms, codifies and transmits the genetic information of the cell.

DORSAL: same as posterior.

DORSUM: anatomical part or structure corresponding in position to the back; posterior in the human.

DOSE, ABSORBED: quantity of energy imparted to a mass of material exposed to radiation.

DOSE, MAXIMUM PERMISSIBLE: the maximum absorbed dose of ionizing radiation to which legal regulations permit a person to be exposed.

DOSE, SURFACE: X-ray dose measured in roentgens at the surface of a structure.

DOSE, X-RAY: amount of radiation delivered to a specified area or volume of the body.

DOSIMETER: instrument used to detect and measure an accumulated dosage of radiation. It is used for personnel monitoring.

DRYING PROCESS: removal of water from the emulsion of an X-ray film so that it may be freely handled.

EDEMA: the presence of abnormally large amounts of fluid in the intercellular tissue spaces of the body; usually applied to demonstrable accumulation of excessive fluid in the subcutaneous tissues.

EFFUSION: escape of fluid from its normal location into another part or tissue.

EGG CELL (oosphere): female germ cell, which in combination with a sperm cell will produce a new individual.

ELECTRIC CURRENT: see current, electric.

ELECTRICITY, STATIC: see static electricity.

ELECTRODE: an electrical conductor through which a current enters or leaves a liquid, a gas, or other nonmetallic portion of the circuit.

ELECTROMAGNET: a temporary magnet made by passing an electric current through a coil of wire surrounding a core of soft iron.

ELECTROMAGNETIC RADIATION: radiation consisting of associated and interacting electric and magnetic waves that travel at the speed of $3x10^{10}$ centimeters per second in a vacuum. Examples are visible light, radio waves, X rays, gamma rays, etc.

ELECTROMAGNETIC WAVE: a wave produced by the oscillation of an electric charge.

ELECTROMAGNETISM: magnetism produced by an electric current.

ELECTRON: an elementary particle with a unit negative electrical charge and a mass of 1/1837 that of the proton.

ELECTROSTATIC: pertaining to static electricity.

ELEVATE: to lift up, raise.

EMBOLISM: sudden blocking of an artery or vein by a clot or obstruction which has been brought to its place by the blood current.

EMESIS: the act of vomiting.

EMPHYSEMA: air or gas in a normally airless tissue or an excess of air in normally aerated tissues.

EMPYEMA: pus in a cavity.

EMULSION: chemical coating of photographic film sensitive to radiation. Consists of halides of silver (bromide, chloride, and iodide) mixed with gelatin.

EMULSION SPEED: measure of the sensitivity of a film; determined by minimum exposure required to produce a predetermined density.

ENDOCHONDRAL: method by which bones form from cartilage.

ENDOSTEUM: the vascular membranous layer of connective tissue lining the medullary cavity of bones.

EPICONDYLE: an eminence upon a bone above its condyle. It is usually roughened for attachment with muscles and/or tendons.

EPIDERMIS: outer and nonvascular layer of the skin. It is protective and composed of four layers.

EPIGLOTTIS: the fibrocartilaginous structure that prevents solids and liquids from entering the larynx and trachea. It is situated on the upper border of the larynx and is leaf-shaped.

EPIPHYSEAL LINE: the line of junction between the epiphysis and the body of the bone; often confusing in the determination of hairline fractures in this region.

EPIPHYSIS: a process of bone which is attached for a time to the body of the bone by cartilage but which later completely ossifies to the body of the bone. The growth in length of the long bones occurs at this cartilaginous joint before maturity of the individual is reached.

EPITHELIUM: the type of tissue forming the epidermis.

ERECT POSITION: upright position of the body, either standing or sitting.

ERYTHEMA: a redness of the skin following exposure to certain irritants. It is due to congestion of the capillaries.

ERYTHEMA DOSE: in radiography, the minimum quantity of X radiation that will produce the appearance of erythema in a particular part of the skin. The quantity of the dose will vary from part to part on the same individual and among different individuals.

ESOPHAGUS: portion of the digestive tract between the pharynx and the stomach.

ETHMOID: one of the bones of the cranial section of the skull; sievelike, perforated.

ETIOLOGY: study of the causation of any disease.

EVERSION: a turning outward; of the foot, turning the foot outwardly or laterally.

EXACERBATION: increase in the severity of any symptoms or disease.

EXCISE: to cut out or off.

EXCRETE: to throw off, as waste matter, by a normal discharge.

EXHALE: breathe out.

EXOSTOSIS: an abnormal bony or osseous outgrowth on a bone surface.

EXPIRATION: act of breathing out or expelling air from the lungs.

EXPOSURE, RADIATION: see radiation exposure.

EXPOSURE, RADIOGRAPHIC: the process of exposing an X-ray film to the action of a beam of X rays after they have passed through a part of a patient's body.

EXPOSURE RATE: the radiation exposure (measured in roentgens or equivalent) per unit of time at a given location.

EXPOSURE TIME: in radiography, the exposure time is measured in seconds. The milliamperes-second (mAs) regulates the quantity of X radiation emitted from the X-ray tube and the film density.

EXTENSION: straightening out, stretching.

EXTERNAL: outside.

EXTERNAL ROTATION: of the humerus; to rotate the hand laterally with the palm forward in the true antero-posterior (posterior) position.

EXTRAVASATION: a discharge or escape, as of blood, from a vessel into the tissues.

EXTREMITY: an arm or leg; the terminal part of anything.

EXTREMITY, LOWER: lower limb, including the hip, thigh, leg, ankle and foot.

EXTREMITY, UPPER: upper limb, including the shoulder, arm, forearm, wrist and hand.

EXUDATE: collection of material that has filtered through the walls of vessels into the surrounding tissues.

FACET: smooth depression on the surface of a bone for articulation with another bone.

FASCIA: a sheet or band of fibrous tissue such as lies deep under the skin or forms a sheath for muscles.

FB: abbreviation for foreign body.

FEMUR: bone that extends from the pelvis to the knee, being the longest and largest bone in the body.

FFD: abbreviation for focus-film distance.

FIBROSIS: development of fibrous tissue.

FIBULA: smaller of the two bones of the leg.

FILAMENT, X-RAY TUBE: spiral tungsten wire constituting the cathode of the X-ray tube;

when heated, it emits electrons.

FILM BADGE: package of photographic film used for approximate measurement of radiation exposure of an individual. The badge may contain a single film or two or three films of differing sensitivity, and it may contain a filter which shields part of the film from certain types of radiation.

FILM BASE: transparent cellulose acetate supporting medium for the radiographic emulsion.

FILM CONTRAST: see contrast, film.

FILM, DIRECT EXPOSURE: film designed for use without screens, in a cardboard film holder.

FILM EMULSION: same as emulsion.

FILM HOLDER: a device to support film so that it will remain flat and in desired position during exposure and to protect it from exposure to light and to rough handling.

FILM, SCREEN: film especially sensitive to the fluorescent light of intensifying screens and designed to be used with such screens.

FILM SPEED: same as emulsion speed.

FILM, X-RAY: photographic film especially designed to be sensitive to X rays.

FILTRATION: causing an X-ray beam to pass through materials that absorb low-energy photons to a relatively greater extent than high-energy photons before the beam reaches the patient.

FISSURE: any narrow furrow, cleft, or slit, normal or otherwise.

FIXER: chemicals that change the undeveloped silver halide crystals of a film emulsion from an insoluble to a soluble form.

FLUORESCENCE: ability of a substance to give off light (fluoresce) when more energetic electromagnetic radiation hits it.

FLUORESCENT SCREEN: (1) same as intensifying screen; (2) a panel coated with a fluorescent material for use in fluoroscopy.

FLUOROSCOPY: process of examining the tissues by viewing on a fluorescent screen the differences in transmission of X rays.

FOCAL SPOT: that part of the target in the anode of an X-ray tube which the electron beam strikes.

FOCUS-FILM DISTANCE: see distance, focus-film.

FOCUSING CUP: a concave structure behind the filament of an X-ray tube shaped to focus or aim the electrons at the target in the anode.

FOG, FOGGING: a generalized darkening of an X-ray film that is not a part of the desired image.

FOG, AGE: either uniform or mottled fogging due to use of outdated film or to storage of unexposed film in high temperatures and excessive humidity.

FOG, CHEMICAL: fog caused by chemical action other than that of normal development; includes effects of development at an excessively high temperature and use of oxidized or deteriorated developer.

FOG, LIGHT: fog caused by accidental exposure of film to light.

FOG, RADIATION: (1) fog caused by exposure to penetrating radiation from radioactive materials or X-ray sources other than in radiographic exposure; (2) fog caused by secondary radiation produced during radiographic exposure.

FORAMEN: perforation or opening (usually in a bone) through which nerves or blood vessels pass.

FOREIGN BODY: material that does not belong in the place where it is found, especially material not of biological origin in the body.

FOSSA: a pit or depression in a bone. Cavity.

FRACTURE: a break of a bone or cartilage.

FRACTURE TYPES: Colles'-of the radius, from 1/2 to 1 inch above the distal end, with posterior and lateral displacement of the hand; comminuted-the bone broken into more than two pieces at one site; compound-puncture of the skin at the fracture site; compression-occurring in the vertebrae, smashing part or all of the bone to a lesser thickness; double-two fractures at two locations, one each, in any one bone; greenstick-in young persons, one side of the bone remains whole, but the other side is fractured; impacted-usually at one end of a long bone, the end being driven into the adjacent end or surface of another bone; incomplete-similar to the greenstick fracture, also a hairline not extending through the entire bone; oblique-at an angle other than horizontal or vertical; simple-a noncomplicated fracture; Smith's-same as Colles' fracture except about 5 cm above the distal end; spiral-one complete fracture in a spiral shape around the shaft of the bone; spontaneous-occurring spontaneously, as in bones having pathology; ununited-in which there has been no union.

FREQUENCY: number of cycles of a wave passing a point per second.

FRONTAL: anterior or ventral.

FRONTAL PLANE: same as coronal plane.

FS: abbreviation for focal spot.

GANGLION: (1) a group of nerve cell bodies located outside the central nervous system; (2) a form of cystic tumor occurring on a tendon sheath.

GAMMA RAY: ionizing electromagnetic radiation, similar to X rays but usually of shorter wavelength, emitted by radioactive substances.

GELATIN: jelly-like protein substance obtained from animal tissues by boiling, used in X-ray film manufacture to suspend the silver salts on the film base.

GENE: the fundamental unit of inheritance; the set of genes carries the information that determines the individual traits of the organism.

GENETICS: the study of heredity.

GLAND: an organ that produces a substance to be used in or excreted from the body.

GLENOID: having the shape of a socket; pertaining to the joint surface of the scapula where it meets the humerus in the shoulder region.

GLENOID FOSSA: the depression for articulation with the condyle of the mandible.

GLOVES, LEADED: a protective device worn by persons whose hands must come close to the X-ray beam.

GLOTTIS: the voice apparatus of the larynx, consisting of the true vocal cords and the opening between them.

GLUTEAL: pertaining to the region of the buttocks.

GONAD: an ovary or testis. A gland which produces reproductive cells.

GONAD SHIELD: a protective shield containing lead to protect against stray or scattered radiation.

GRAININESS: coarseness of texture of the radiographic image when silver is deposited in clumps instead of finely divided.

GRID: a device which consists of a series of alternate radiopaque and radiolucent strips, each deeper than it is wide. When interposed between patient and film, the grid allows primary radiation to pass through the radiolucent strips while most of the secondary radiation strikes and is absorbed by the radiopaque strips.

GRID LINES: shadows on the film caused by the lead strips in a grid.

GRID RADIUS: strips in some grids are angled so that their planes converge toward a point, called the focus. The radius is the distance from the focus to the surface of the grid.

GRID RATIO: ratio of the depth of the lead strips in a grid to the width of the radiolucent separators between lead strips.

GROOVE: elongated depression on the surface of a bone; a furrow.

HALF-VALUE LAYER: that thickness of a given material that reduces the intensity of an X-ray beam, in passing through the material, to exactly one-half its original value.

HALOGEN: any of the elements chlorine, bromine, and iodine.

HANGER: a stainless steel frame with clips at each corner to hold an X-ray film firmly during the processing procedure.

HARD X RAYS: high-energy X rays.

HARDENER: chemical (usually potassium alum) used in the fixing bath to harden the X-ray film emulsion after development.

HEART: organ in the thoracic cavity composed of cardiac muscle that maintains the circulation of the blood.

HEAD: the portion at the end of a bone, usually rounded.

HEEL EFFECT: intensity variation from side to side of an X-ray beam in the direction of the tube axis.

HEMATOMA: a tumor or swelling containing blood.

HEMOGLOBIN: the oxygen-carrying pigment of the red blood cells (erythrocytes).

HERNIA: protrusion of a part of an organ through an opening.

HETEROGENEOUS RADIATION: see radiation, heterogeneous.

HIATUS: a gap, cleft, or opening.

HIATUS, ESOPHAGEAL: the opening in the diaphragm for the esophagus and vagus nerves.

HIATUS (HIATAL) HERNIA: protrusion of any structure through the esophageal hiatus of the diaphragm.

HILUM (plural, hila): same as hilus.

HILUS (plural, hili): the part of an organ where nerves and blood vessels enter and leave.

HOLDER, FILM EXPOSURE: a radiolucent cardboard and envelope device used to hold an X-ray film for exposure purposes. The back of the holder is lined with a thin sheet of lead to protect the film from radiation backscatter. The envelope mounted between the cardboard covers is to enclose the X-ray film.

HORIZONTAL PLANE: any plane that divides the body into superior (upper) and inferior (lower) portions.

HUMERUS: the upper arm bone.

HVL: abbreviation for half-value layer.

HYDROQUINONE: a chemical used as a developer.

HYOID: the U-shaped bone, between the root of the tongue and the larynx, that supports the tongue and gives attachment to its muscles.

HYPERTENSION: abnormally high tension; especially, high blood pressure.

HYPERTROPHY: excessive growth or overgrowth.

HYPO: common name for sodium or ammonium thiosulfate, used in fixing baths; hence, used as a name for the fixing bath.

HYPOCHONDRIUM: region of the abdomen below either costal arch.

HYPOGASTRIUM: the lower middle region of the abdomen, above the symphysis pubis and below the umbilical region.

HYPOMOTILITY: deficient power of movement in any part.

ID: abbreviation for identification marker.

IDENTIFICATION MARKER: information imprinted by exposure on a film to identify the patient, to designate the right and left sides of the body parts, and to give other essential information.

ILIUM: the expansive superior portion of the hip bone. It is a separate bone in early life.

ILLUMINATOR, X-RAY: a viewing device for radiographs. It consists of a metal box containing fluorescent lights covered by a sheet of opal glass or plastic to diffuse the transmitted light.

IMAGE: the shadow of the various details of the anatomical structures through which the X-ray beam passed, and in which it was absorbed in varying degrees.

IMAGE, LATENT: atomic changes, corresponding to the radiographic image, that occur in the silver bromide crystals in the emulsion of an X-ray film upon exposure which render the crystals reducible to metallic silver upon development.

IMAGE, RADIOGRAPHIC: a pictorial record of the internal structural elements of a part of the body, as projected by X rays on an X-ray film. It consists of deposits of black metallic silver of varying concentration on the radiograph.

IMAGE SHARPNESS: the clarity of the details of a radiograph.

IMMOBILIZATION: the process of making a body part motionless during a radiographic exposure.

INCISION: (1) a cut, or wound produced by cutting; (2) the act of cutting.

INCISURA: an indentation on the edge of a bone or other structure.

INFARCT: death of a body tissue resulting from obstruction of circulation to it.

INFERIOR: lower or below; farther from the head. Under, bottom, or plantar surface of bone.

INGUINAL: pertaining to the groin.

INHALE: breathe in.

INHERENT FILTER: those materials which the X-ray beam must pass through that are necessary parts of the tube, its housing, and electrical insulation.

INNOMINATE: so-called unnamed bone of the pelvis, composed of the ilium, ischium and pubis.

INSPIRATION: act of drawing air into the lungs.

INSULT: an injury.

INTENSIFYING SCREEN: a cardboard coated with fluorescent material designed to fit in a cassette in contact with an X-ray film in order to increase the exposure efficiency.

INTENSITY, X-RAY: see X-ray intensity.

INTERNAL: inside.

INTERNAL ROTATION: of the humerus; to rotate the hand medially with the palm facing laterally.

INVERSE SQUARE LAW: the intensity of the unobstructed beam of X radiation at the film varies inversely as the square of the focus-film distance (FFD).

INVERSION: a turning inward, upside down, or other reversal of the normal direction of a part.

INTRATHORACIC: within the chest.

ION: an atom or molecule that has lost or gained one or more electrons and is therefore electrically charged; also, a free electron.

ION PAIR: a closely associated positive ion and negative ion (usually an electron) having charges of the same magnitude and formed from a neutral atom or molecule by radiation.

IONIZATION: the process of producing ions.

IONIZING RADIATION: radiation that is energetic enough to produce ions.

ISCHIUM: inferior and posterior part of the innominate bone.

ISOTOPE: any specific one of the forms of an element that differ in atomic weight because of differences in numbers of neutrons.

JOINT: articulation; place in the skeleton where two or more bones meet.

JOINT, FREELY MOVABLE (diarthrosis): an articulation which has cartilage covering contiguous surfaces. Connecting capsule, composed of ligaments, is lined with a synovial membrane which exudes lubricating fluid. Example: elbow, knee.

JOINT, IMMOVABLE (synarthrosis): surfaces of bones almost in direct contact. Bones are fastened by intervening connective tissue. Example: sutures of the skull.

JOINT, SLIGHTLY MOVABLE (amphiarthrosis): contiguous surfaces of bones connected by fibrocartilaginous disks or an interosseous ligament. Example: pubis.

KILOVOLT: a unit of electrical force or electromotive force; 1,000 volts. Abbreviated kV.

KILOVOLTS PEAK: the voltage, in kilovolts, at the crest of the AC wave form; the maximum voltage applied between the cathode and the anode during any specific mode of operation of an X-ray tube. Abbreviated kVp; also pkV.

kVp: abbreviation for kilovolts peak.

KYPHOSIS: condition commonly called humpback; dorsal convexity of the spine.

LACERATION: (1) act of tearing; (2) a wound made by tearing.

LAMBDOID: a suture between the occiput, parietal and temporal bones; similar in shape to the Greek letter lambda.

LAMINA: a thin flat plate or layer; used in anatomical nomenclature as a general term to indicate such a structure, or a layer of a composite structure.

LAMINATED: having many thin layers.

LAMINOGRAPH: a piece of X-ray apparatus which makes a radiograph of a layer of tissue at any specified depth; a tomograph.

LAMINOGRAPHY: use of the laminograph to show in detail images of structures lying in a predetermined plane of tissue, while blurring or eliminating detail of images of structures in other planes; tomography.

LANDMARK: an anatomical structure used as a point of orientation in locating other structures.

LAO: abbreviation for left-anterior-oblique.

LARYNX: voice box; the cartilaginous portion of the air passage extending from the base of the tongue to the trachea.

LATENT IMAGE: see image, latent.

LATENT PERIOD: the period between a radiation insult and the appearance of symptoms resulting from that insult.

LATERAL: toward the side of the body; away from the median plane.

LATERAL PROJECTION: a radiographic position in which the X-ray beam passes from the right or left side of the patient to the other side.

LATITUDE: the range of exposure between the minimum and maximum that will provide a radiograph acceptable for diagnostic purposes.

LEADED APRON: see apron, leaded.

LESION: (1) a wound; (2) a localized change in tissues due to disease.

LEUKEMIA: fatal disease of the blood-forming organs, characterized by a marked increase in the number of leukocytes and their precursors in the blood, together with enlargement and proliferation of the lymphoid tissue of the spleen, lymphatic glands, and bone marrow.

LIGAMENT: a band of tissue that connects bones, or supports viscera or muscles.

LIMITED PERMITTEE: same as X-ray technician.

LINE DROP: drop of voltage in the conductors of a power or lighting circuit.

LOADING BENCH: a workbench used in a film-processing darkroom primarily to load and unload film-holders.

LOBE: a more or less well-defined portion of any organ, especially of the lung, brain, liver and glands. Lobes are demarcated by fissures, sulci, connective tissue, and by their shape.

LONG BONE: classification of bone; found in extremities. Each has long, usually cylindrical shaft with two expanded extremities.

LORDOSIS: abnormally increased concavity in the curvature of the lumbar spine as viewed from the side; forward curvature of the lumbar spine.

LPO: abbreviation for left-posterior-oblique.

LUMBAR SPINE: the portion of the vertebral column below the thorax which forms the posterior support of the abdominal cavity and is attached to the sacrum below.

LUMEN: cavity or hollow space in an organ or tube.

LUNG: the organ of respiration which aerates the blood.

LUXATION: displacement of any part, especially dislocation of a bone.

LYSHOLM GRID: a stationary grid of thin, parallel lead strips which is used like a Bucky diaphragm.

mA: abbreviation for milliampere.

MAGNIFICATION: extent to which image elements in a radiograph are larger than corresponding structures in the body.

MALIGNANT: said of a tumor that tends to infiltrate surrounding tissues and give rise to metastases.

MEDIAL: relating to the middle or center.

MEDIAN PLANE: see midsagittal plane.

MESIAL: see medial.

METABOLISM: all the many life processes by which a living organism is produced and maintained; for example, the absorption of oxygen and the disposal of waste products by the lungs.

METACARPALS: bones of the hand.

METAPHYSIS: wider part at the extremity of the shaft of a long bone, adjacent to the epiphysis.

METASTASIS: the translocation of disease from its primary site to a secondary site via the blood or lymph.

METATARSUS: the bones of the foot, between instep and toes.

MICTURATE: to urinate.

MIDAXILLARY LINE: imaginary line extending from the axilla to the crest of the ilium.

MIDLINE: a median line.

MIDSAGITTAL PLANE: vertical plane that divides the body into equal right and left halves; median plane.

MILLIAMPERE: unit of electric current; 1/1000 ampere. Abbreviated mA. The radiographic exposure factor that regulates the intensity of radiation emitted by the X-ray tube. It directly influences the radiographic density.

MILLIAMPERAGE: tube current of X-ray tube stated in milliamperes.

MINI-FILM: miniature film.

MITOSIS: the reproduction of cells by cell division, the nucleus of the cell dividing first, followed by the cytoplasm.

MITRAL VALVE: left atrioventricular valve of the heart, shaped like a miter.

MOLECULE: a chemical combination of two or more atoms of the same or different kinds which form a specific chemical substance.

MORBID: pertaining to or affected with disease.

MORIBUND: in a dying state.

MORPHOLOGY: branch of biology dealing with structure and form without regard to function.

MOTILITY: the ability to move spontaneously.

MOTION: movement of a body or part, which produces a blurred image. Motion can be reduced or minimized (1) by immobilizing the part with sand bags or a compression band; (2) by suspended respiration during examination; (3) by using the shortest possible exposure (generally requires the use of intensifying screens).

MPD: abbreviation for dose, maximum permissible.

MUSCLE: contractile tissue made of bundles of fibres, with the function of causing movement of body parts.

MUSCLE, CARDIAC: involuntary muscle of the heart.

MUSCLE, INVOLUNTARY: not able to be controlled directly by the will.

MUSCLE, VOLUNTARY: able to be controlled by the will.

MUTANT: variation from the parent stock that breeds true in future generations.

MUTATION: a permanent transmissible change in the characteristics of an offspring from those of its parents.

MYELOGRAM: a radiograph of the spinal cord after introducing a radiopaque substance into the surrounding space.

NARIS (plural, nares): nostril. One of the openings of the nasal cavity.

NASAL: pertaining to the nose.

NASOPHARYNX: part of the pharynx located above the soft palate.

NATURAL RADIOACTIVITY: radioactivity of naturally occurring substances.

NAVEL: the umbilicus.

NAVICULAR: (1) a boat-shaped bone of the tarsus; (2) a small bone of the wrist in the proximal row.

NECORSIS: death of tissue, usually as individual cells, groups of cells, or in small localized areas.

NEOPLASM: any new and abnormal growth, such as a tumor.

NERVE: a cordlike structure that conveys impulses between a part of the central nervous system and some other region of the body.

NEURAL: pertaining to a nerve or to the nerves.

NEUTRAL: (1) neither acid nor basic; (2) not electrically charged.

NORMAL ANATOMICAL POSITION: arbitrarily taken to be the erect (standing) position, with the feet flat on the floor, arms at the sides, and palms, toes and eyes directed forward.

NOSTRIL: naris. One of the external apertures of the nose.

NON-SCREEN FILM: X-ray film with a faster emulsion than that of film, intended for use in cardboard holders.

NOTCH: deep indentation or narrow gap in the edge of a part.

NUCLEUS (ATOM): the small, positively charged core of an atom which contains nearly all the atom's mass.

NUCLEUS (CELL): the central controlling body and reproductive center of a cell.

NUCLIDE: an element in any one specific isotopic form.

OBESE: extremely fat, corpulent.

OBJECT: the body or organ being examined.

OBJECT-FILM DISTANCE: see distance, object-film.

OBLIQUE PROJECTION: a radiographic position in which the part is placed at an inclined angle to the film or with the central ray (CR) directed obliquely. In a true oblique projection, the part is rotated 45°.

OCCIPUT: a bone of the skull; forms the posterior portion and base of the skull.

OCCLUDE: to fit close together; to close tight, as to bring the mandibular teeth into contact with the teeth in the maxillae.

OCCLUSAL PLANE: the plane of the masticating surfaces of the molar and bicuspid teeth of the upper and lower jaws when the jaws are closed.

OCCLUSION: complete meeting or meshing of the teeth of the upper and lower jaws.

ODONTOID: resembling a tooth; toothlike projection from the upper surface of the body of the second cervical vertebra, known as the dens.

OFD: abbreviation for distance, object-film.

OLECRANON: proximal bony projection of the ulna at the elbow, its anterior surface forming part of the trochlear notch.

OLECRANON FOSSA: depression on the posterior surface, on the lower end of the humerus.

OLECRANON PROCESS: same as olecranon.

OPACITY: resistance to transmission of light or X rays.

OPAQUE: impervious to light rays or, by extension, to X rays.

OPTIC: pertaining to the eye.

ORAL: pertaining to the mouth.

ORGAN: any part of the body having a definite function to perform.

OS: (1) (plural, ora) a mouth; opening; (2) (plural, ossa) a bone.

OSSEOUS: of the nature or quality of bone; bony.

OSSEOUS SYSTEM: bony skeleton.

OSSICLE: small bone.

OSSIFICATION: bone formation.

OSTEOBLASTS: bone-forming cells.

OSTEOCLASTS: bone-destroying cells.

OSTEOLOGY: study of the bones and their structure.

OSTEOMYELITIS: inflammation or infection of bone marrow.

OSTEOPOROSIS: abnormal porosity or rarefaction of bone.

OVARY: the female gonad.

OXIDATION: process by which oxygen in the air combines with chemicals in developer and fixer solutions.

PA: abbreviation for posterior-anterior.

PALMAR: pertaining to the palm surface of the hand.

PALPATE: to examine by touch.

PARALYSIS: loss or impairment of motor functions in a part due to lesion of the neural or muscular mechanism.

PARAPLEGIA: paralysis of the legs and lower part of the body, both motion and sensation being affected.

PARIETAL: (1) the lateral or outer aspect; (2) a large, flat bone forming the side wall of the cranium.

PARTICULATE RADIATION: see radiation, particulate.

PASS BOX: a lead-lined compartment, built between the darkroom and another room or passageway, which allows exposed and unexposed films in cassettes to be transferred to and from the darkroom and radiographic rooms.

PATELLA: sesamoid bone located in the knee; kneecap.

PATHOLOGY: branch of medical science dealing with the modifications of functions and changes in structure caused by disease.

PEAK KILOVOLTAGE: same as kilovolts peak.

PECTORAL: concerning the chest.

PELVIS: (1) the bony ring formed by the two innominate bones, the sacrum, and the coccyx; (2) a basin or basin-shaped cavity, as the pelvis of the kidney.

PENUMBRA: ill-defined margin of a shadow caused by the fact that the source of radiation is larger than a point.

PERICARDIUM: fibroserous sac that surrounds the heart, comprising an external layer of dense fibrous tissue and an inner serous layer. The base of the pericardium is attached to the central tendon of the diaphragm.

PERIOSTEUM: fibrous membrane covering bone surfaces except at points of attachment of tendons and ligaments and at articular surfaces.

PERISTALSIS: peculiar wavelike contractions of tubular structures as in the digestive tract.

PERITONEUM: serous membrane lining the abdomen and surrounding the viscera.

PHALANX (plural, phalanges): one of the bones of the fingers or toes.

PHARYNX: throat; the musculomembranous pouch situated posteriorly to the nose, mouth and larynx.

PHLEBOLITH: a small, rounded calcium deposit in the wall of a vein.

PHOSPHOR: any substance that gives off light when excited by radiation.

PHOSPHORESCENCE: ability of a substance (zinc sulfide, etc.) to continue to give off light after the activating source has ceased.

PHOTOFLUOROGRAPHY: photographic recording of fluoroscopic images on small films using a fast lens.

PHOTOGRAPHIC EMULSION: same as emulsion.

PHOTOGRAPHY: the art or process of obtaining images on sensitized surfaces by the action of light or other radiant energy.

PHOTON: a bundle (quantum) of electromagnetic radiation.

PHOTOTIMER: instrument, usually consisting of a photomultiplier tube and associated electronic circuits, designed to terminate radiographic exposures automatically when a specified exposure is reached.

PHYSIOLOGY: study of the normal functions and activities of living organisms.

pkV: abbreviation for peak kilovoltage.

PLANTAR: pertaining to the sole of the foot.

PLEURA (plural, pleurae): serous membrane enveloping the lungs and lining the thoracic cavity. There are two pleurae (right and left), entirely distinct from each other.

POPLITEAL NOTCH: deep notch (intercondylar) between the condyles of the femur, best demonstrated on the tunnel view.

PORT: the opening in the tube housing through which the primary beam passes.

POSTERIOR: nearest or toward the back or rear. Back part of the body; opposite to anterior. Abbreviated P.

POSITION: the placement of the patient in relation to the film-holder or the X-ray table.

POSITION, ANATOMICAL: same as normal anatomical position.

POSITION, ANTERIOR-POSTERIOR (anteroposterior): position in which the central ray (CR) enters perpendicularly to the anterior surface of the part and emerges from the posterior surface. Abbreviated AP.

POSITION, ANTERIOR-POSTERIOR OBLIQUE, right or left: position in which the X ray passes from the anterior to the posterior surface of the body at an oblique angle. In the right anterior-posterior oblique position, the right posterior side of the body is nearest the film. In the left anterior-posterior oblique position, the left posterior side is nearest the film.

POSITION, POSTERIOR-ANTERIOR: position in which the central ray (CR) enters perpendicularly to the posterior surface and emerges from the anterior surface.

POSITION, POSTERIOR-ANTERIOR OBLIQUE, right or left: position in which the X ray passes from the posterior to the anterior surface of the body at an oblique angle. In the right posterior-anterior oblique position, the right anterior side of the body is nearest the film. In the left posterior-anterior oblique position, the left anterior side is nearest the film.

POTTER-BUCKY DIAPHRAGM: same as Bucky diaphragm.

PR: abbreviation for radiation, primary.

PRESERVATIVE: a chemical placed in an X-ray developer to reduce the amount of oxidation of the reducing agents by the air. Sodium sulfite is the chemical usually employed. It is also used in the fixer to prevent decomposition of the sodium thiosulfate by acid.

PRIMARY RADIATION: see radiation, primary.

PROCESS: a projecting part of an anatomical structure.

PROCESSING, FILM: chemical treatment of an exposed X-ray film that results in the production of a radiographic image. It involves the processes of development, rinsing, fixation, washing, and drying.

PROJECTION: the direction of the X-ray beam through the body part to the film.

PRONATION: act of being in the prone position.

PRONE: lying with the anterior surface or the face down; opposite of supine.

PROSTHESIS: replacement of a missing part by an artificial substitute.

PROTON: an elementary atomic particle with a single positive electrical charge and a mass approximately 1,837 times that of the electron.

PROXIMAL: nearest the middle of the body or the origin of the organ; opposite of distal.

PSOAS MUSCLES: heavy muscles of the spine.

PUBIC BONE: part of the innominate bone forming the anterior portion of the pelvis, uniting anteriorly with its fellow to form the symphisis pubis.

PULMONARY: pertaining to the lungs.

PYLORUS: the muscular, circular opening of the stomach into the duodenum.

QUADRANT: one of the four regions into which the abdomen may be divided for physical diagnosis.

QUALITY, X-RAY: property determined by the distribution of intensities among the various wavelengths.

QUANTUM (plural, quanta): a unit of energy under the quantum theory.

QUANTUM THEORY: the theory that the radiation and absorption of energy take place in definite quantities called quanta which vary in size and are defined by the equation $E = h\nu$, in which E is the energy of the quantum, h is Planck's constant, and ν is the frequency of the radiation.

RAD: a unit of measurement of the absorbed dose of ionizing radiation, equivalent to an energy transfer of 100 ergs per gram of the absorbing material.

RADIATION: the emission and propagation of energy through matter or space by means of electromagnetic disturbances which display both wave-like and particle-like behavior. In this context, the packets of energy so propagated are known as photons.

RADIATION, HETEROGENEOUS: X rays consisting of a mixture of many different wavelengths.

RADIATION, IONIZING: see ionizing radiation.

RADIATION, PARTICULATE: ionizing radiation other than electromagnetic waves, such as alpha or beta particles.

RADIATION, PRIMARY: all radiation coming directly from the target of an X-ray tube.

RADIATION PROTECTION: radiation protection requires minimum exposure for both the X-ray technician and the patient. To eliminate all unnecessary exposure, a technician must adhere to the rules of safe practice in the performance of his work. Carelessness in X-ray radiography is intolerable. All necessary protective devices and procedures for both the technician and the patient must be utilized (properly functioning machine, lowest possible exposure, leaded apron, leaded gloves, leaded shield). Overexposure must be reported promptly to the proper authority.

RADIATION, REMNANT: that portion of the primary radiation (PR) that emerges from the body tissues to expose the X-ray film and record the radiographic image. Abbreviated RR.

RADIATION, SECONDARY: radiation originating as the result of scattering of other radiation in matter. It may be electromagnetic or particulate in nature.

RADIATION THERAPY: the use of radiation of any type in the treatment of disease.

RADIOACTIVITY: process whereby certain nuclides undergo spontaneous disintegration in which energy is liberated, generally resulting in the formation of new nuclides. The process is accompanied by the emission of one or more types of radiation such as alpha and beta particles and gamma photons.

RADIOGRAPH: permanent photographic record of the structures through which a beam of ionizing radiation has passed.

RADIOGRAPHY: that diagnostic procedure which depends on the differential absorption of X rays traversing a part of the patient's body to emerge, to expose an X-ray film, and to produce a radiographic image.

RADIOISOTOPE: an isotope which is radioactive.

RADIOLOGIST: a physician who has had specialized training and experience in radiology.

RADIOLOGY: that branch of medical science which deals with the use of radiant energy (such as X rays) in the diagnosis and treatment of disease.

RADIOLUCENT: permitting the easy passage of X rays, yet offering some resistance to them.

RADIONUCLIDE: same as radioisotope.

RADIOPAQUE: obstructing the passage of X rays.

RADIUM: a radioactive element used in the treatment of disease. Chemical symbol, Ra.

RAMUS: a branch; slender process of bone projecting from the main part.

RAO: abbreviation for right-anterior-oblique.

RATIO, GRID: see grid ratio.

RAY, CENTRAL: see central ray.

RAY, GAMMA: see gamma ray.

RBE: abbreviation for relative biological effectiveness.

REACTION, CHEMICAL: an interaction of substances in which the identity of the materials involved is altered.

RECESSIVE: in genetics, pertaining to a gene that cannot express itself as a trait until matched with an identical recessive gene.

RECUMBENT: lying down.

RECUMBENT LATERALLY: body on the side in a horizontal position.

REDUCING AGENT: a chemical with the power to change silver salts to metallic silver.

RELATIVE BIOLOGICAL EFFECTIVENESS: the ratio of the absorbed dose of a specific kind of radiation to the absorbed dose of X rays required to produce the same biological effect. Abbreviated RBE.

REM: abbreviation for roentgen-equivalent-man.

REMNANT RADIATION: see radiation, remnant.

REPLENISHER: solutions for strengthening and prolonging the life of the developer or fixer. There is a specific replenisher for each of the two solutions.

RESPIRATION: act of breathing.

RESTRAINER, DEVELOPER: see developer restrainer.

RIGOR MORTIS: the muscular rigidity that occurs following death.

RNA: ribonucleic acid; a nucleic acid found in all living cells. Messenger RNA transfers information from DNA to the protein-forming system of the cell.

ROENTGEN: the unit of X-ray exposure; a measure of the number of ion pairs produced by the radiation in each cubic centimeter of air at standard conditions of temperature and pressure. Abbreviated R.

ROENTGEN-EQUIVALENT-MAN: the quantity of any ionizing radiation which has the same biological effectiveness as 1 roentgen of X rays.

RPO: abbreviation for right-posterior-oblique.

RR: abbreviation for remnant radiation.

RULE-OF-THUMB: a photographic rule-of-thumb to change radiographic density by workable amounts may be employed by either halving or doubling the mAs, provided the kilovoltage employed is optimum for the part being examined.

SACRUM: a curved triangular bone composed of five united segments situated between the fifth lumbar vertebra above and coccyx below and the innominates on each side, and forming the posterior boundary of the pelvis.

SAFELIGHT: a low-powered electric light enclosed in a lightproof metal housing with an amber-colored filter on one face, to give illumination in which X-ray film may safely be handled for a limited period of time.

SAGITTAL PLANE: any plane parallel to the median plane.

SANDBAGS: bags of sand (or rice), of various sizes and shapes, used for immobilizing the part to be X-rayed.

SARCOMA: a type of malignant neoplasm.

SCAPULA: the large, flat, triangular bone forming the back of the shoulder.

SCATTERED RADIATION: same as secondary radiation.

SCOLIOSIS: appreciable lateral deviation in the normally straight vertical line of the spine.

SCREEN: same as intensifying screen.

SCREEN FILM: see film, screen.

SCREEN, INTENSIFYING: see intensifying screen.

SCREEN SPEED: the effectiveness of a given screen in amplifying the photographic power of X rays; usually expressed in descriptive terms such as high, low, and medium.

SCROTUM: the double pouch containing the testicles and part of the spermatic cord.

SECONDARY RADIATION: see radiation, secondary.

SECTIONAL RADIOGRAPHY: same as laminography.

SEPTUM: membranous wall dividing two cavities.

SEQUESTRUM: a detached or dead piece of bone within a cavity, abscess, or wound.

SEROUS FLUID: clear, watery fluid secreted by many membranes of the body, such as the pleural cavity and the peritonium.

SERRATED: having a sawlike edge.

SERUM: (1) serous fluid; (2) the fluid part of the blood after coagulation; (3) an antitoxin.

SESAMOID: a small bone shaped like a seed; auxiliary bones found at articular surfaces, especially in the hands and feet. The patella is the largest of these.

SHAFT: the long cylindrical part, or the principal portion, of a bone.

SHORT BONE: a cube-shaped bone, composed of spongy bone enclosed in a thin shell of compact bone.

SILVER HALIDE: a compound of silver with one of the halogens.

SINUS: (1) a normal cavity in a bone or organ, containing air; (2) a tract in soft tissues for the escape of deep-seated infectious material.

SKELETON: internal structure composed of bone and cartilage that protects and supports the soft organs, tissues, and parts of the body.

SLUDGE: a white precipitate in the fixing solution or a white scum on the film due to an excessive amount of developer carried over into the fixing tank. The developer tends to precipitate some of the hardening agent.

SOFT TISSUE RADIOGRAPHY: radiographic examination of the soft tissues of the body.

SOFT X RAYS: low-energy X rays which have little penetrating power.

SPECTRUM, ELECTROMAGNETIC: description of the behavior and practical application of electromagnetic waves of specific ranges of wavelengths.

SPEED, EMULSION: see emulsion speed.

SPEED, SCREEN: see screen speed.

SPERM CELLS: male germ cells, one of which in combination with an egg cell will produce a new individual.

SPERMATOZOA: mature sperm cells.

SPINA BIFIDA: a developmental anomaly characterized by a defect in the bony encasement of the spinal cord.

SPINA BIFIDA OCCULTA: a congenital cleft in the neural arch which is hidden or which has no visible protrusion of the spinal membranes.

SPINE: (1) spinal column; (2) a pointed projection of bone.

SPINOUS PROCESS: that part of the vertebra which projects backward from the arch, giving attachment to muscles.

SPONDYLITIS: inflammation of the vertebrae.

SPONDYLOLISTHESIS: forward displacement of one vertebra over another, usually of the fifth lumbar over the body of the sacrum, or of the fourth lumbar over the fifth.

SPOT, FOCAL: see focal spot.

STATIC ELECTRICITY: an electric charge at rest, usually produced by friction between dissimilar substances.

STATIC MARKS: artifacts on radiographs that are the result of electrical discharges on the film surface.

STEREOSCOPIC EXAMINATION: X-ray examination which produces an impression of the third dimension, depth.

STERILE: (1) not fertile; not capable of producing young; (2) aseptic, not containing microorganisms.

STERNUM: breast bone. There are three parts: manubrium, or first part; body or mid-portion; xiphoid process, distal portion.

STRAY RADIATION: radiation not serving any useful purpose. It includes direct radiation and secondary radiation from irradiated objects.

STYLOID: resembling a pillar; long and pointed.

STYLOID PROCESS: pointed projection of a bone such as the radius or the ulna.

SUBLUXATION: incomplete or partial dislocation.

SUPERFICIAL: on or near the surface.

SUPERIOR: above or higher; nearer the head end.

SUPINATION: act of assuming the supine position or the state of being supine. Applied to the hand, the act of turning the palm forward (anteriorly) or upward, performed by lateral rotation of the forearm.

SUPINE: lying on the back, face upward.

SURFACE DOSE: dose of radiation measured in roentgens at the surface of a structure.

SUSTENTACULUM TALI: a process of the calcaneus that supports the talus.

SUTURE: (1) a type of fibrous joint between bones in which the opposed surfaces are closely united; (2) surgical stitching or stitching material.

SYMPHYSIS: (1) a cartilaginous junction of two bones; (2) symphysis pubica or pubis, the joint between the two pubic bones.

SYNOVIA: the fluid that lubricates joints and tendons and fills the bursae.

TALUS: second largest bone of the tarsus, the major weight-supporting bone of the body.

TARGET: see X-ray tube target.

TARGET-FILM DISTANCE: see distance, target-film..

TARSUS: bones of the foot.

TECHNIQUE, OPTIMUM kVp: optimum kilovoltage technique is based on standardization of the processing procedure and the reduction of all exposure factors to constants for a given projection with the exception of one variable, mAs. The kilovoltage is fixed for a given projection and the mAs is the variable.

TENDON: white fibrous tissue which attaches muscle to bone.

TESTIS: the male gonad.

TFD: abbreviation for distance, target-film.

THERMIONIC EMISSION: the release of electrons when a material is heated.

THICKNESS, AVERAGE RANGE: employed for radiographic projections as a guide to exposure. They are based on the frequency with which certain groups of thicknesses occur as measured for a given projection.

THORACENTESIS: surgical puncture of the chest wall with drainage of fluid.

THORACIC: pertaining to or situated in the chest or thorax.

THORACIC CAVITY: chest cavity containing lungs, heart, and mediastinum, and separated from the abdomen by the diaphragm.

THORACOPLASTY: plastic surgery of the thorax; operative repair of defects of the chest.

THORAX: the chest.

THROMBUS: a plug or clot in a blood vessel or the heart, formed by coagulation of the blood, and remaining at the point of its formation.

TIBIAL: refers to the tibia bone. Sometimes used as a synonym for medial in the leg and distal portions.

TISSUE: a group of cells of similar origin, structure and function.

TOMOGRAPH: same as laminograph.

TOTAL FILTRATION: inherent filtration plus any added filtration.

TRABECULA: one of the fibers extending from the capsule into the interior of an organ, as in the spongy tissue of bones.

TRACHEA: cartilaginous and membranous tube descending from the larynx to the bronchi.

TRANSLUCENT: allowing light to pass through but diffusing it so that objects cannot be distinctly seen.

TRANSVERSE: placed crosswise; situated at right angles to the long axis of a part.

TRANSVERSE PLANE: same as horizontal plane.

TRAUMA: a wound or injury.

TROCHANTER: one of the projections on the femur near its head, serving as points of attachment of muscles.

TROCHLEA: grooved convexity at the distal end of the humerus for articulation of the olecranon process of the ulna.

TROUGH: the low spot in a wave form; the opposite of a wave crest.

TSD: abbreviation for distance, target-skin.

TUBE HOUSING: the lead-shielded container that holds the X-ray tube, insulating oil, and, in some equipment, transformers.

TUBE TARGET: see X-ray tube target.

TUBE, X-RAY: see X-ray tube.

TUBERCLE: a small, rounded projection on a bone for the attachment of a tendon, ligament, o or muscle.

TUBEROSITY: same as tubercle.

TUMOR: (1) a swelling, one of the cardinal signs of inflammation; morbid enlargement; (2) a neoplasm; a mass of new tissue which persists and grows independently of its surrounding structures and which has no physiologic use.

ULNA: inner and larger bone of the forearm, on the side opposite that of the thumb.

ULNAR DEVIATION: hand, pronated, is rotated laterally to its limit, while wrist and forearm remain fixed.

UMBILICUS: the navel; the round, depressed scar in the median line of the abdomen where the umbilical cord was attached.

VACUUM TUBE: a sealed tube with the contained gas exhausted to a pressure low enough to permit the passage of electrons between electrodes projecting into the tube from the outside. Sometimes called a valve or electron tube.

VALVE: same as vacuum tube.

VASCULAR: containing numerous blood vessels.

VEIN: a blood vessel carrying blood from the tissues to the heart.

VENA CAVA: inferior vena cava brings blood from lower extremities and abdominal and pelvic viscera to the right atrium of the heart. Superior vena cava brings the blood from the head, neck, chest, and upper extremities to the right atrium.

VENTRAL: (1) anterior; (2) relating to the abdomen.

VENTRICLE: a small cavity, such as one of the several cavities of the brain or one of the lower chambers of the heart.

VENULE: a tiny vein continuous with a capillary.

VERTEBRA (plural, vertebrae): any one of the thirty-three bones of the spinal column.

VERTEBRA PROMINENS: the seventh cervical vertebra, so called because of the length of its spinous process.

VERTEX: the crown of the head; a summit or top.

VERTICAL: perpendicular to the plane of the horizon or to a primary axis; upright.

VERTICAL POSITION: see position, vertical.

VESICLE: (1) a small, saclike cavity; (2) a circumscribed, elevated, fluid-containing lesion of the skin, 5 mm or less in diameter.

VESTIGIAL: of the nature of a vestige, trace or relic; rudimentary.

VISCERA: plural of viscus.

VISCUS: any large interior organ in any one of the three great cavities of the body, especially in the abdomen.

VOLAR: pertaining to the palm of the hand.

VOLT: unit of measure of electrical pressure or electromotive force.

VOLTAGE: electromotive force that drives the electric current through an electrical circuit.

WAVELENGTH: distance between the peaks or troughs of any two adjacent cycles of a wave.

WINDOW: the thin wall of glass in an X-ray tube, opposite the focal spot, through which the primary beam of X rays passes.

WOUND: a rupture of the continuity of an inner or outer surface of the body.

WRIST: the part of the upper extremity between the hand and the forearm. The carpus as distinguished from the metacarpus and containing the carpal bones.

XERORADIOGRAPHY: from the Greek word xeros, meaning "dry"; physical, rather than chemical, production of a permanent radiograph without the use of liquids.

XIPHOID: sword-shaped; the distal portion of the sternum.

X RAY: electromagnetic radiation of very short wavelength possessing the properties of (1) penetration of matter; (2) exposure of photographic materials; (3) excitation of fluorescence; (4) ionization of matter. The useful band of wavelengths for medical radiography is 0.50 to 0.100 angstrom units.

X-RAY BEAM: see beam, X-ray.

X-RAY FILM: see film, X-ray.

X-RAY INTENSITY: rate (roentgens per second) at which X radiation reaches a specified location.

X-RAY TECHNICIAN (PERMITTEE): Limited Permittee means any person who has been issued a limited permit pursuant to the California Administrative Code, Title 17, Chapter 5, Subchapter 4.5. Only a limited permittee may use the title consisting of his limited permit category plus the words, X-Ray Technician. Limited permits may be issued in the following categories: (1) chest radiography; (2) dental laboratory radiography; (3) gastrointesntinal radiography; (4) genitourinary radiography; (5) leg radiography; the knee and distal portions; (6) musculoskeletal radiography; (7) photofluorographic chest radiography; (8) skull radiography; (9) extremities radiography.

X-RAY TECHNOLOGIST (CERTIFIED RADIOLOGIC TECHNOLOGIST): a Certified Radiologic Technologist means any person, other than a licentiate of the healing arts or a limited permittee, making application of X rays to human beings pursuant to the California Administrative Code, Title 17, Chapter 5, Subchapter 4.5. Radiologic Technologists certified pursuant to the above referenced regulations may use the title Certified Radiologic Technologist (CRT). No other person may use such designation. The certificate issued to the CRT allows the practice of diagnostic radiologic technology without limitation as to procedures or areas of application.

X-RAY TUBE: the glass vacuum tube that contains the anode, cathode and filament which are the basic elements in X-ray production.

X-RAY TUBE FILAMENT: see filament, X-ray tube.

X-RAY TUBE TARGET: the area on the anode of an X-ray tube which, when it is struck by electrons, produces X rays.

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